

# NATIONAL RAILROAD PASSENGER CORPORATION

## AMT-2

### ELECTRICAL OPERATING RULES and INSTRUCTIONS

These rules and instructions are issued for the protection of all personnel, property, and operation of trains and locomotives in electrified territory. Compliance is mandatory by all personnel affected by these rules and instructions.

All employees working in electrified territory must obtain and keep with them while on duty, a copy of the AMT-2 and pass the required examinations before they are assigned to duty in electrified territory.

Bulletins will be issued as necessary and will contain information related to the rules, procedures and other instructions to AMT-2 Electrical Operating Rules and Instructions. Employees governed by these instructions must have bulletins for the manuals on which they are qualified readily available for inspection or review upon request.

The use of the male gender throughout this publication is for convenience and clarity only. All rules apply equally to male and female personnel.

Document not controlled when viewed outside of Comply365 Application.

**Revised and Reissued April 7, 2025**

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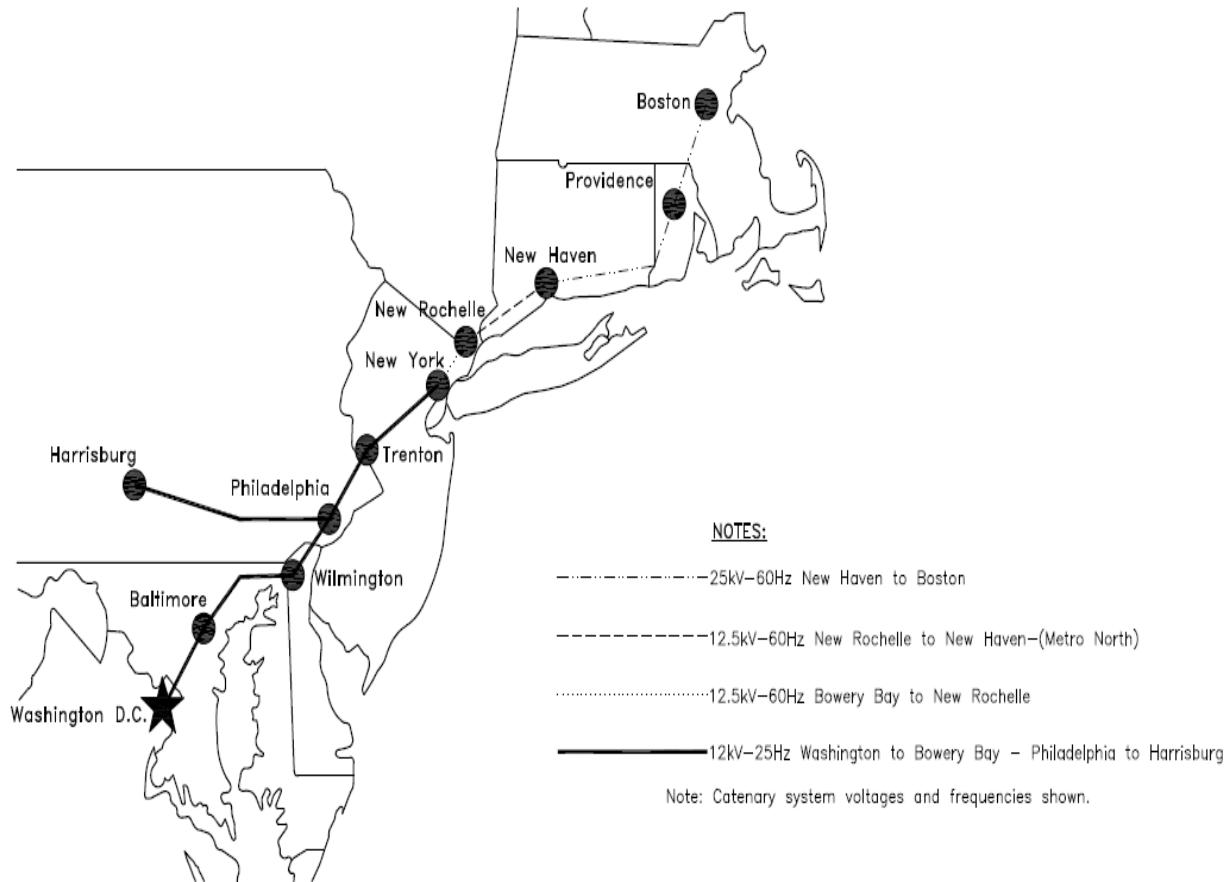


Figure 1 - AMTRAK AC ELECTRIFIED TERRITORY

## 1. GENERAL INSTRUCTIONS FOR ALL EMPLOYEES

- 1.101** Safety is of the first importance in the discharge of duty. These rules provide for a safe and efficient operation. In case of doubt, the safe course must always be followed.
- 1.102** All Employees working in electrified territory must attend required training and successfully pass the AMT-2 Electrical Operating Rules and Instructions examination.
- 1.103** Employees who have passed the required AMT-2 examination are classified as Class "A", "B", or "C". Class "A" and "B" Employees must pass the AMT-2 examination annually. Class "C" Employees must pass the AMT-2 examination every two years. Employees who fail this examination or allow their qualifications to lapse, will not perform duties in Electrified Territory. Employees qualifying in any month will carry qualifications to the last month of the following calendar year.
- 1.104** ET Trainees are not eligible for Class "A" AMT-2 until:
  - A. Line and Substation Trainees have successfully completed their 12 month training.
  - B. Third Rail Trainees have successfully completed their 8 month training.
- 1.105** Class "A" Employees must demonstrate their qualifications annually to retain Class "A" qualification.
- 1.106** All Employees working on exposed circuits energized at 50 volts or greater must be trained in First Aid and Cardiopulmonary Resuscitation (CPR), unless working in a facility with designated First Aid and trained employees readily available. Electric Traction Employees must be trained annually. All other Employees must be trained every two years.
- 1.107** When working on circuits energized at 600 volts or greater, two Employees must be on the site.
- 1.108** Do not work on or about an electric circuit, apparatus, or equipment unless qualified and authorized.
- 1.109** Before touching a structure carrying a live circuit, examine it to ensure that it is not energized due to broken insulator, slack wire, or other such condition. If in doubt, contact the Power Director.
- 1.110** Insulation, weather proofing, or covering on wire, electrical apparatus, or equipment must not be depended upon for protection against shock.
- 1.111** Personnel are prohibited from getting on top of any high equipment while under the energized catenary system.
- 1.112** Personnel must not enter substations, converter stations, or electrical enclosures unless qualified and authorized.
- 1.113** The Power Director must be advised of all personnel entering any substation or ET enclosure.
- 1.114** Conductive material such as steel tape measure, wire, wet or non-rated rope, or linen tape-line containing metallic reinforcement must not be used around energized wire, apparatus, equipment, or third rail.
- 1.115** When any rule cannot be complied with, all work must STOP. The Deputy Chief Engineer – ET or his designated representative, must be informed of the circumstances before proceeding with work.

## 1.2 EMERGENCY CONDITIONS

- 1.201 All occurrences or conditions which are likely to affect electric operation must be reported immediately to the Power Director/Train Dispatcher.
- 1.202 When an overhead wire or third rail failure occurs that may obstruct tracks, all tracks that may be affected must be protected immediately.
- 1.203 When necessary to de-energize the overhead wires or third rail to prevent personal injury or damage to property, Power Director/Train Dispatcher must be notified immediately. Persons notifying the Power Director/Train Dispatcher will identify themselves, their location, the emergency, and await instructions.
- 1.204 Employees in electrified territory will be familiar with the location and operation of radios and telephones.
- 1.205 When using railroad telephone lines or radios, the word "EMERGENCY" repeated three times indicates an emergency. All others using the phone line or radio channel must yield immediately.
- 1.206 Employees must not touch unidentified dangling wires, trees, or foreign objects in contact with overhead lines or third rail. Do not attempt to move them. Take necessary precautions to protect others and equipment. All Employees must maintain MINIMUM APPROACH DISTANCE. (See Tables 1 & 2)
- 1.207 When using extinguishers, the operator must consider all electrical apparatus and wires energized until they have been de-energized, tested de-energized, and grounded as necessary.
- 1.208 Handheld fire extinguishers should never be used in such a way that the stream can strike any electrical apparatus until power has been removed and the wires grounded, if possible. Employees must never attempt to extinguish an electrical fire using water.
- 1.209 Fire extinguishing apparatus should be available as required by Amtrak policies and procedures.
- 1.210 Fires in proximity to overhead wires may interrupt power and must be reported immediately to the Power Director/Train Dispatcher. The Power Director will, when necessary, send a Class "A" Employee to the scene of the fire. When flames or when fire fighting apparatus, hose streams, or loose portions of buildings may come in contact with overhead wires or third rail, power must be removed.
- 1.211 In case of fire on electric equipment or electrical apparatus, the power must be removed at once. The circuit must be grounded, if possible, before using fire extinguishers suited for electrical fires.
- 1.212 During a fire, all persons must keep as far as possible from energized high voltage conductors, which might fall. Arrangements must be made to have such wires de-energized, tested de-energized, and grounded as necessary.

**1.213** In the event that a victim has been identified as having received an electric shock, ensure that the area has been assessed and all hazards have been mitigated. The safety of the rescuer is first and foremost when assessing the situation. Every emergency situation is unique, but each requires the rapid execution of a number of critical tasks:

- A. Contact emergency assistance (Amtrak Police Department, 911, Power Director, or Train Dispatcher as appropriate)
- B. Administer appropriate care to the victim.
- C. Notify appropriate company personnel.

**1.214** Release of victim from contact with live conductors:

- A. Extreme care must be exercised in releasing a victim from contact with a live conductor to avoid shock or burns to the rescuer.
- B. If the victim or the live conductor is in a pool of water, do not step into the water.
- C. Do not touch the live conductor.
- D. Do not touch any part of the victim as long as he is in contact with the live conductor.
- E. Class "A" or "B" Employees may use an approved hot line tool to push the conductor away from the victim while keeping hands the appropriate minimum approach distance away from the victim. Rubber gloves must also be worn.
- F. If the above approach is not practical for any reason, the conductor must be de-energized and tested de-energized as quickly as possible and grounds applied as necessary, before attempting to release the victim.

### **1.3 MINIMUM APPROACH DISTANCE**

**1.301** Employees working in electrified territory must always maintain MINIMUM APPROACH DISTANCE. MINIMUM APPROACH DISTANCE is measured between the person or the end of a tool, equipment, or material being used and the exposed energized parts. (See Table 1 & 2)

**1.302** All overhead wires must always be considered energized (LIVE), except when it is known to be de-energized, tested de-energized, and grounded.

**1.303** The third rail must always be considered energized (LIVE), except when it is known to be de-energized, tested de-energized, and a Third Rail Warning Device applied.

**1.304** All work on electrical lines or equipment having a nominal voltage ABOVE 480 volts AC, must be de-energized, tested de-energized, and properly grounded.

**1.305** When work requires protection be provided by a Utility Company, either grounds must be visually verified prior to start of work, or a Utility Company representative must be on site to verify the wires are de-energized and grounded.

#### **1.4 CLASS "A" PROTECTION**

**1.401** Before work is to be performed under the protection of a Class "A" Employee, a Briefing must be received and acknowledged by all Employees requiring protection. The Briefing must include but is not limited to the following information:

- A. Boundaries of where work may be performed
- B. Location of nearby energized circuits
- C. Site specific hazards
- D. Location of temporary protective grounds (if any)
- E. Clearing information

**1.402** When additional Employees requiring protection join the group it is the responsibility of the Person in Charge to notify the Class "A" Employee and request a Briefing.

**1.403** A Class "A" employee must ensure another Class "A" employee is transferred the responsibility of oversight before leaving a job site. If a Class "A" employee cannot be present, the person in charge must be notified and work in the vicinity of the circuitry or apparatus must cease with all persons and equipment at a safe distance. The Class "A" Employee will obtain all required signatures on a standard clearance form or permit before their departure.

**1.404** The Class "A" Employee holding the clearance will inform the Person in Charge when any Employee is not working safely or will not comply with instructions. The Class "A" Employee will stop all work and notify the Power Director if the Person in Charge fails to adhere to their instructions.

**1.405** All Personnel signing a Clearance Form must acknowledge the fact that they have received, understand, and were afforded the opportunity to ask questions of the Class "A" Employee who obtained the Clearance.

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OVERHEAD WIRES			
	Contractor	AMT-2 Qualified Class "B" or "C" Personnel	AMT-2 Qualified Class "A" Personnel
	(ft.)	(ft.)	(ft.)
Personnel not protected by Class "A" Employee, wires energized or de-energized not grounded			
Transmission Wires	15	8	8
Catenary	15	3	3
Signal Line	15	3	3
Utility Wires less than 35000 volts	15	3	3
Personnel protected by Class "A" Employee, wires energized or de-energized not grounded			
Transmission Wires	8	8	8
Catenary	3	3	3*
Signal Line	3	3	3
Utility Wires less than 35000 volts	3	3	3
Equipment operating in the vicinity of wires energized or de-energized not grounded			
Transmission Wires	15	15	15
Catenary	15**	3	3
Signal Line	15**	3	3
Utility Wires less than 35000 volts	15**	3	3
Personnel and Equipment being provided protection by Class "A" Employee, wires de-energized, tested de-energized, and grounded			
All Conductors	Full Contact		
Unidentified Dangling Wires			
Unidentified Dangling Wires	15	15	8

\*18 inches permissible at Steady Spans with Class "A" supervision per AMT-2 4.126

\*\*Up to 3 feet when protected by a Class "A" Employee

Table 1 - MINIMUM APPROACH DISTANCES

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THIRD RAIL MINIMUM APPROACH DISTANCES		
Personnel	Distance	Description
Contractors	4 feet	Unless protection has been provided by a qualified Class "A" Third Rail Employee
AMT-2 Qualified Personnel	4 feet	Working with conductive tools or equipment
AMT-2 Qualified Personnel	6 inches	While walking over and around third rail
Class "A" Third Rail Personnel*	6 inches	Contact may only be made with energized third rail with Supervisor's permission and utilizing rubber gloves, leather gauntlets, and insulated tools
AMT-2 Qualified Personnel working under rubber mat protection provided by Class "A" Third Rail Employee	18 inches	Non-conductive tools, equipment, or material must not come within 18 inches of exposed energized third rail

\* Third Rail Trainees must not work on energized Third Rail until Qualified

Table 2 - THIRD RAIL MINIMUM APPROACH DISTANCES

## 1.5 PANTOGRAPHS

**1.501** Electric engines and Multiple Units (MU) under overhead wires must be considered energized (LIVE), except when it is known that all pantographs are down and pantograph grounding switches are closed, or overhead wires are de-energized, tested de-energized, and properly grounded.

**1.502** When practical, the condition of pantograph(s) must be observed by the engineer and/or train crew at station stops. Wayside personnel should observe operating pantograph(s) of passing trains. In case of defective pantograph(s), the Power Director/Train Dispatcher must be notified. Engineers are responsible for taking corrective action when defects are identified.

**1.503** When there are visible defects or obstructions in the catenary that may damage pantographs, pantographs must be dropped, and catenary conditions and the location of the defect(s) must be reported to the Power Director/Train Dispatcher.

**1.504** When a broken wire or obstruction that may damage a pantograph is found in the catenary, a hand signal must be given to approaching electric equipment.

A. Hand signal to drop or raise pantograph: Swing arm in a circular motion at full arm's length, at a right angle to the track.



Figure 2 – DROP PANTOGRAPH HAND SIGNAL

B. Engineer will drop pantograph(s) immediately. Engineer will acknowledge by two short sounds of the horn.

C. After all pantographs have passed the affected area the engineer may raise pantograph(s).

**1.505** When pantographs are damaged, electric equipment must be stopped immediately, notify the Train Dispatcher, and await instructions. The Class "A" or "B" Employee may go to the roof of electric equipment and remove or secure broken pantograph, or renew pantograph components only after:

A. Overhead wire has been de-energized, tested de-energized, and properly grounded by a Class "A" Employee.

B. Position and condition of all overhead wires has been reported to the Power Director/Train Dispatcher.

**1.506** Electric equipment must not be moved from electrified to non-electrified tracks or from non-electrified to electrified tracks unless pantographs are down.

**1.507** Where two pantographs are located on one unit, they are electrically connected. The pantograph in the UP position energizes the pantograph that is in the DOWN position. When either of the pantographs is in the UP position, both pantographs must be considered energized (LIVE) until such time as the jumpers are physically removed from between the pantographs/cars. Married pair cars have a high voltage bus jumper connecting the pantograph on one unit to the transformer on the second unit. High Speed Trainset (HST) Type 1 power units are considered separate units. HST Type 2 (Acela 21) power units are electrically connected.

**1.508** Pantograph poles must be carried on all AC propelled equipment. When a pantograph pole is used to raise or lower pantographs, the pantograph pole must be used by a Class "A" Employee only.

**1.509** Pantograph poles stored on AC propelled equipment must be removed from service every 2 years for inspection, evaluation, and electrical testing.

## **1.6 IMPEDANCE BONDS AND APPLICATION OF TEMPORARY JUMPERS**

**1.601** Loose or broken impedance bond connections in the tracks must be regarded as energized (LIVE).

**1.602** In electrified territory, before disconnecting leads of impedance bonds or removing section of rail, care should be exercised to ensure a return path for traction current is maintained.

**1.603** Before working with impedance bond neutral connections, it is necessary that all connections be identified to ensure proper protection from hazardous energy. Before disturbing any connection with an unknown neutral connection, the Electric Traction Department must be contacted for inspection by a Class "A" qualified Employee to determine any additional requirements for protection above those established herein.

**1.604** Method of applying temporary rail jumpers in electrified territory when impedance bond side leads are to be removed or when neutral of bonds are to be opened. (See Figure 3)

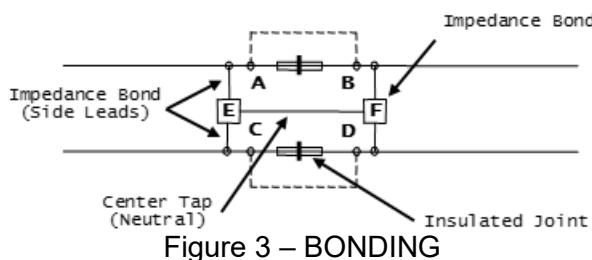


Figure 3 – BONDING

Make jumper connections A - B and C - D before disconnecting side leads of impedance bond E or F, rails, or opening a neutral bond, allow the jumper connections to remain in place until impedance bonds are properly connected to rails. Jumpers must not be applied until use of track has been obtained and Maintenance of Way Employee has protected apparatus and train movements.

**1.605** Method of applying temporary rail jumpers in electrified territory when rail, to which impedance bond is connected, is to be removed from track. (See Figure 4)

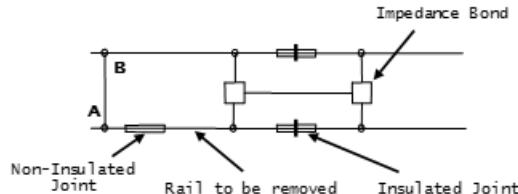


Figure 4 - BONDING

Make jumper connections A - B before impedance bond connection to rail is removed. Allow connection A - B to remain in place until the new rail is installed and impedance bond connected to it. Jumpers must not be applied until use of track has been obtained and maintenance of way Employee has protected apparatus and train movements.

**1.606** Method of applying temporary rail jumpers in electrified territory when rail is to be removed from track. (See Figure 5)

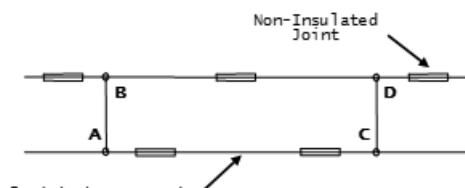


Figure 5 - BONDING

Make jumper connections A - B and C - D before rail or rail bonds are to be removed. When new rail is in place and joint bars tightened, remove jumpers A - B and C - D. Jumpers must not be applied until use of track has been obtained.

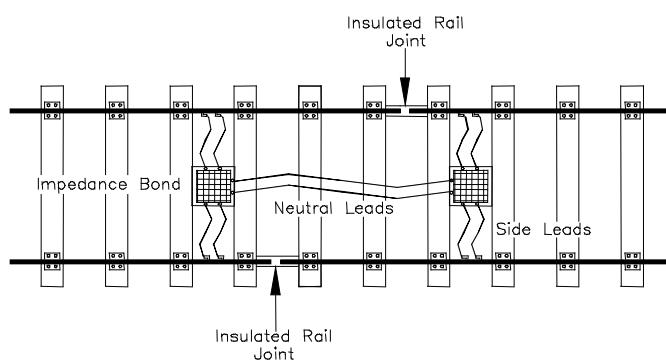


Figure 6 - STANDARD IMPEDANCE BOND ARRANGEMENT

Note: Impedance bonds may be found in areas where insulated joints are not present.

## **1.7 BONDING AND GROUNDING**

- 1.701** Any equipment used in electrified territory, must be grounded in accordance with ET Specification No. 16064. It is the responsibility of the operator to know that such equipment is properly grounded.
- 1.702** When applying equipment grounds, ensure that both surfaces are clean and free of corrosion or insulating material.
- 1.703** Any metallic fencing or other electrically conductive infrastructure within electrified railroad right-of-way must be bonded to prevent touch potential hazards.

## **1.8 USE OF APPROVED BARRIERS**

- 1.801** Approved barriers may be used by contractors or Class "C" employees to protect workers from contact with energized circuits as outlined in these instructions.
- 1.802** Design of a proposed barrier must be submitted to and approved in writing by the Deputy Chief Engineers – ET and Structures or their designated representative.
- 1.803** Barrier design must consider clearance envelope for the movement of trains, where applicable.
- 1.804** Barriers must be constructed to maintain electrical clearances to energized parts, as listed below. Wire deflection due to wind or pantograph movement must be considered when calculating these distances.

Voltage (V)	Minimum Clearance (inches)	
	Horizontal	Vertical
750 DC	12	6
1,000-35,000 AC	18	9*
>35,000-138,000 AC	72	72

\*Barriers of timber construction require 12". Clearance to grounded steel is 9".

- 1.805** Barriers constructed from metallic materials must be securely bonded to ground.
- 1.806** Barriers constructed from non-metallic materials must have a ground wire secured to the top of the barrier.
- 1.807** Barriers must be secured and un-movable from the time it is placed in service until the time the barrier is no longer needed and removed.
- 1.808** Barriers used as walking/working surfaces for vertical clearances above energized parts must be constructed in such a way that no access to areas below exists.
  - A.** Any gaps along edges or in seams must be filled with foam or other expanding agent to completely seal protected area.
  - B.** Barriers must be designed and constructed not to allow water or other conductive fluids from leaking onto energized parts. Water or other fluids must be channeled away from the energized areas and allowed to drain safely.
  - C.** Barriers must be designed and constructed to prevent debris from falling through and contacting energized parts or equipment.

**1.809** Barriers used for horizontal clearances must be constructed solidly. If necessary to allow wind to pass through, small weep holes must be arranged so that extraneous items such as hoses, wire, cable, and tools cannot protrude through the protected area.

- A. Barriers must be constructed so that the work area is not accessible to the general public or passengers.
- B. Barriers must be a minimum of 6 feet 6 inches above the work area or capped or constructed in such a method so that items cannot be thrown over or around the barrier into the energized area or into the train envelope.
- C. All barriers must contain Danger High Voltage signs at all entrances and every 20 feet, to warn workers of the danger on the other side.
- D. Barriers are prohibited from protecting heavy equipment such as bobcats, mini-excavators, backhoe, etc. unless specifically designed to do so.
- E. Barriers must be constructed under the supervision of a Class "A" Employee to ensure a safe work area during construction.

**1.810** Prior to use, barriers must be inspected and approved by the Assistant Division Engineer – ET or his representative to ensure they meet the submitted design criteria and are sufficient to provide protection.

**1.811** Approved barriers must have an NEC-101 Green Tag affixed in a visible location to indicate an inspection process has been completed.

## **1.9 GENERATORS**

**1.901** Any generator inter-connected to existing electrical systems that are operated or maintained by Amtrak must be reviewed and approved by the Deputy Chief Engineer – ET or his designated representative.

**1.902** Generators that are isolated from the electrical system and used to power tools or lighting do not require approval.

**1.903** Generators must always be located in a well-ventilated area.

**1.904** Permanent generator installations must include a device to prevent back feeding.

**1.905** When a clearance is being taken on equipment or apparatus that can be back fed from a generator, blocking points must be established to prevent unintended back feed.

**1.906** Prior to any generator being connected to an electrical system monitored by the Power Director, the Power Director must be notified.

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AMTRAK POLICE		1-800-331-0008	
Position		ATS	Commercial
BOSTON DISPATCHING OFFICE			
Power Director – Zone 10 East South Station MP 228.7 to Richmond MP 150.1		580 – 6961 580 – 6962	(617) 204 – 6961 (617) 204 – 6962
Power Director – Zone 10 West W83 Richmond MP 150.1 to Mill River MP 72.9		580 – 7714 580 – 7715	(617) 345 – 7714 (617) 345 – 7715
Chief Dispatcher		580 – 7569	(617) 345 – 7569
METRO NORTH RAILROAD			
Power Director – MNRR Mill River MP 72.9 to CP 216 MP 18.7			(212) 340 – 2100
NEW YORK DISPATCHING OFFICE			
Power Director – Zone 1 CP 216 MP 18.7 to Bergen MP 3.2		521 – 7684 521 – 7685	(212) 630 – 7684 (212) 630 – 7685
<b>Emergency Only</b> Power Director – Zone 1		521 - 7911	(212) 630 – 7911
Power Director – Zone 2/3 Bergen MP 3.2 to Holmes MP 76		521 – 7680 521 – 7681	(212) 630 – 7680 (212) 630 – 7681
Asst. Chief Dispatcher		521 – 7465	(212) 630 – 7465
PHILADELPHIA DISPATCHING OFFICE			
Load Dispatcher		728 – 2020 728 – 4046	(215) 349 – 2020 (215) 349 – 4046
WILMINGTON DISPATCHING OFFICE			
Power Director – Zone 8 Paoli MP 21.3 to Harrisburg MP 104		733 – 4680 733 – 4681	(302) 552 – 4680 (302) 552 – 4681
Power Director – Zone 4 Holmes MP 76 to Paoli MP 21.3 to Glenolden MP 8.1		733 – 4640 733 – 4641	(302) 552 – 4640 (302) 552 – 4641
Power Director – Zone 5 Glenolden MP 8.1 to Gunpow MP 79.5		733 – 4650 733 – 4651	(302) 552 – 4650 (302) 552 – 4651
Power Director – Zone 6 Gunpow MP 79.5 to Washington MP 136		733 – 4660 733 – 4661	(302) 552 – 4660 (302) 552 – 4661
Asst. Chief Dispatcher		733 – 4696 733 – 4697	(302) 552 – 4696 (302) 552 – 4697

Table 3 - TELEPHONE NUMBERS\*

\* While Mileposts in the above table are accurate, location names represent the nearest railroad characteristic.

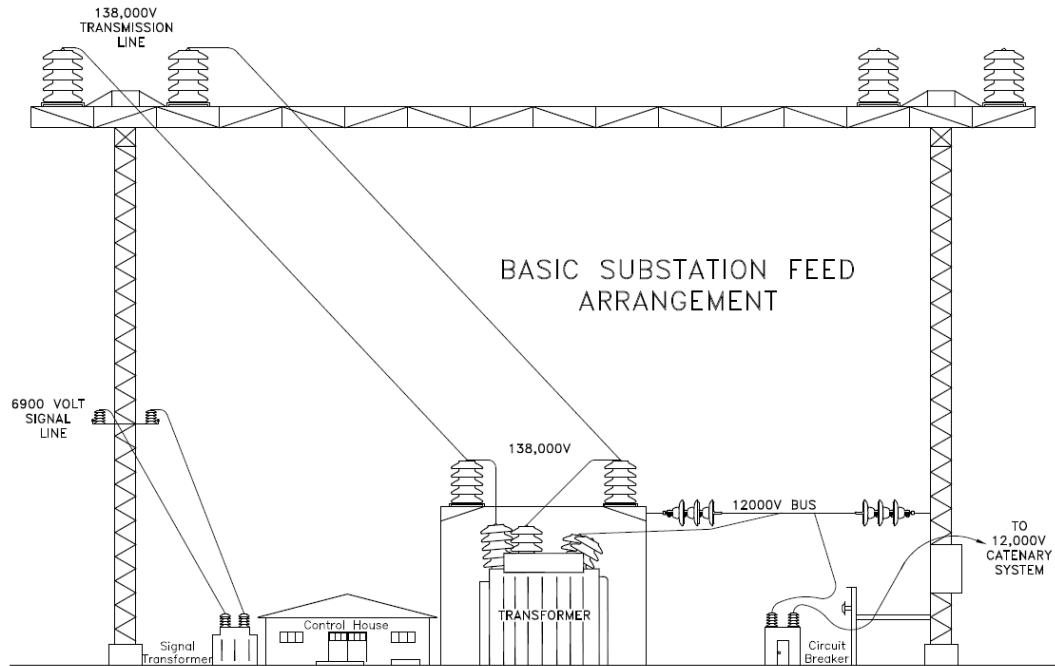
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LOCATION	VOLTAGE	FREQUENCY
CATENARY	AC	Hz
Washington – New York	12,000	25
Philadelphia – Harrisburg	12,000	25
Bowery Bay – New Rochelle	12,500	60
New Haven – Boston	25,000	60
AUTOTRANSFORMER FEEDER		
Bowery Bay – New Rochelle	12,500	60
New Haven – Boston	25,000	60
SIGNAL POWER		
Signal Machine Input	480	25 or 60
Arsenal – Zoo	440	100
Harrisburg – Paoli	6900	100
Hackensack – Gate	2300	91 2/3
Bowery Bay – New Rochelle	7200	100
Zoo – Paoli	3300	100
Lane – Hackensack	6900	91 2/3
Washington – Lane	6900	100
TRANSMISSION LINES		
Hackensack – Washington & Philadelphia – Harrisburg	138,000	25
LOCAL UTILITY SUPPLY		
New England Substation	115,000	60
Sunnyside Converter Station	138,000	60
Metuchen Converter Station – Rotary Output	13,200	25
Metuchen Converter Station – Static	230,000	60
Richmond Converter Station	69,000	60
Lamokin Converter Station – Rotary Output	13,200	25
Safe Harbor – Rotary Output	13,200	25
Jericho Park Converter Station	230,000	60
MECHANICAL		
Head End Power (HEP) and Ground Power	480	60
THIRD RAIL	DC	
New York	750	

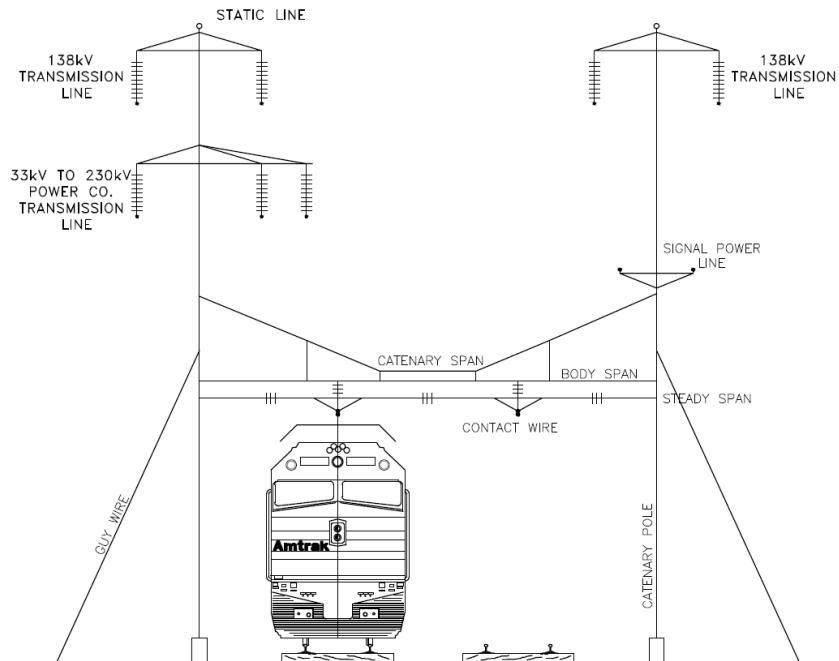
Table 4 - SYSTEM VOLTAGES AND FREQUENCIES

**AMT - 2**  
**ELECTRICAL OPERATING RULES AND INSTRUCTIONS**



**Figure 7 - BASIC 25 Hz SUBSTATION FEED ARRANGEMENT**

**SHOWING UTILITY POWER LINE OCCUPATION**



**Figure 8 - TYPICAL FIXED TERMINATION CATERARY CONFIGURATION**

AMT - 2  
ELECTRICAL OPERATING RULES AND INSTRUCTIONS

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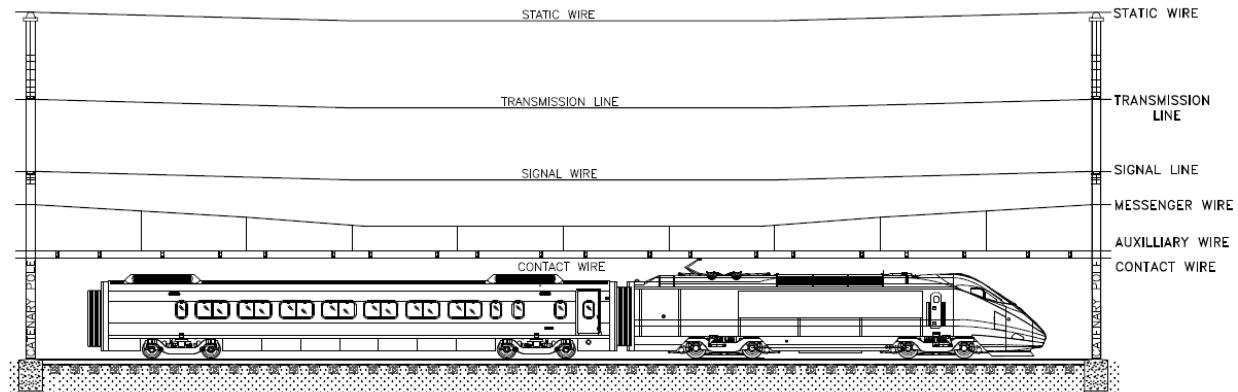


Figure 9 - TYPICAL 25Hz WIRE PROFILE

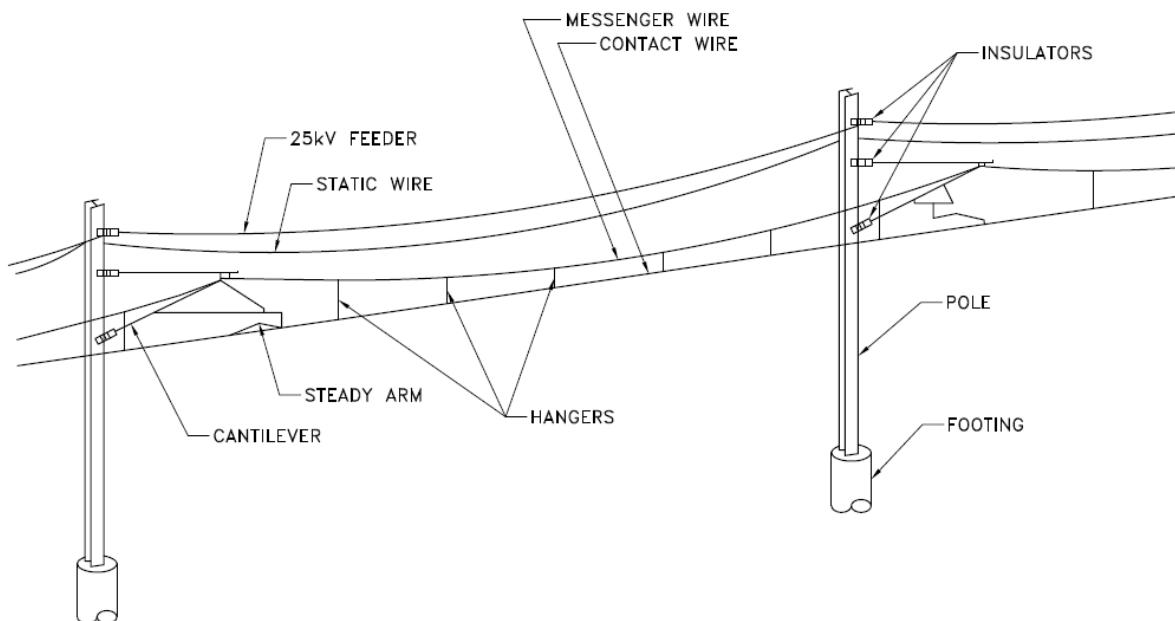


Figure 10 - TYPICAL CONSTANT TENSION CATENARY

AMT - 2  
ELECTRICAL OPERATING RULES AND INSTRUCTIONS

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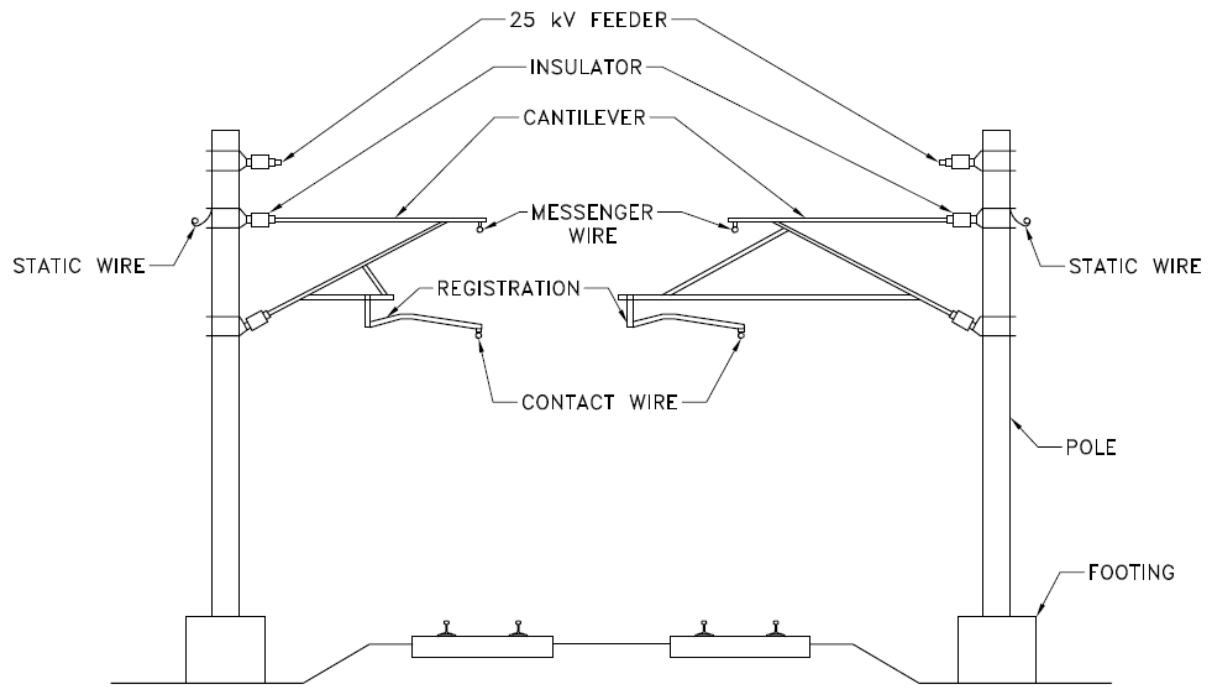


Figure 11 – CONSTANT TENSION SECTION VIEW

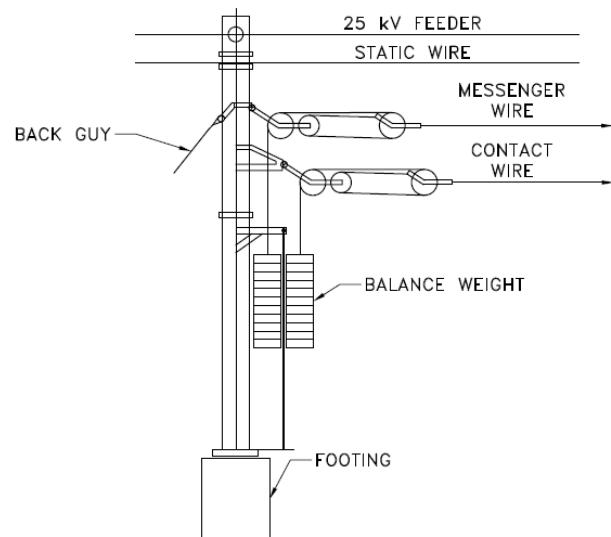


Figure 12 - TYPICAL BALANCE WEIGHT ASSEMBLY AT DEAD ENDS

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## 2. RULES AND INSTRUCTIONS PERTAINING TO TRANSPORTATION PERSONNEL

**2.101** A job briefing must be conducted with each member of the crew prior to operating in electrified territory.

**2.102** The Train Dispatcher, or Employee who has jurisdiction over the area, must not authorize electric trains for movement to tracks not equipped for electric operation or tracks protected by a plate order, until verified that all pantographs are down and secured.

**2.103** When transferring Employees or passengers to an adjacent train, the following rules apply:

- A. Traction power must not be applied on either train until the process is complete.
- B. When in Third Rail Territory, the third rail must be properly de-energized prior to transfer.
- C. Due to a difference in electric potential between equipment, one of the following must be adhered to when transferring passengers to an adjacent train:
  1. If spotting one train adjacent to another, jumper cables must be applied between adjacent equipment prior to transfer.
  2. If staggering trains on an adjacent track, trains must be positioned so that doors do not line up to avoid simultaneous contact between equipment.
  3. If using a non-conductive bridge plate with no jumpers applied, pantographs on both trains must be lowered prior to transfer.

**2.104** Dead Sections (DS) are installed in overhead catenary wires at certain locations specified in Table 5. DS signs designate the limits of these sections. (See Figure 13)

All electric equipment approaching a DS will be governed by the following:  
Place Throttle/Controller in OFF and open the Main Circuit Breaker (MCB), if equipped, keeping it in that position until the DS is passed.



Figure 13 - DEAD SECTION SIGN

## 2.2 PHASE BREAK SIGNS AND INDICATORS

**2.201** Phase Break (PB) Indicators and PB signs (Figure 15) are located as specified in Tables 6 & 7. The PB signs are located on the first catenary pole in advance of a phase break.

**2.202** Position light PB Indicators of the type shown in Figure 14 are located in advance of the PB sign.

**2.203** The Power Director shall notify the Train Dispatcher immediately when a PB Indicator is lit.

**2.204** When a PB indicator is lit, a section of the PB is de-energized, and all electric equipment approaching a PB on the affected track or tracks, as specified by the Timetable, will be governed by the following:

- Electric equipment equipped with an MCB, will place the throttle/controller in the OFF position and open the MCB, keeping it in that position until the PB is passed.
- Multiple Electric Locomotives coupled with both pantographs up on leading unit and rear pantograph up on each trailing unit except through PB (when lit). Drop all pantographs prior to entering the PB and DS.

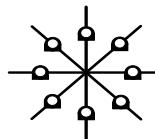


Figure 14 -  
PHASE BREAK  
INDICATOR

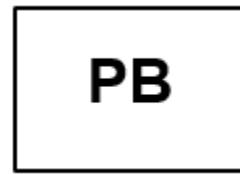


Figure 15 - PHASE  
BREAK SIGN

- One unit of electric equipment, not equipped with an MCB, with one pantograph up will place throttle/controller in OFF position before entering the PB, keeping it in that position until the PB is passed.
- Electric equipment with both pantographs up, or multiple electric equipment, not equipped with an MCB, must place controller in OFF position and drop pantograph(s) before entering PB. Keep pantographs in this position, until PB is passed. Speed must be reduced to 60 MPH before raising pantograph(s).

**2.205** AC Motor Stop signs are placed in the catenary to indicate the end of contact wire. Electric engines and MU equipment must not pass the sign with their pantograph(s) up.

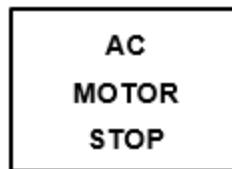


Figure 16 - AC MOTOR STOP SIGN

AMT - 2  
ELECTRICAL OPERATING RULES AND INSTRUCTIONS

Division	Location Relative to Nearest Station	Specific Location of Each Dead Section		
		Trk	West End	East End
NED	West of Mill River	2 & 4	MP 73.21	MP 73.30
		1 & 6	MP 73.17	MP 73.26
	West of Branford	2	MP 78.91	MP 78.98
		1	MP 78.93	MP 79. 01
	West of Brook	2	MP 103.03	MP 103.13
		1	MP 103.06	MP 103.16
	West end Groton	1 & 2	MP 123.62	MP 123.66
	East of High St	1 & 2	MP 150.10	MP 150.21
	West of Cranston	1 & 2	MP 176.88	MP 176.99
	East of Holden	1 & 2	MP 198.92	MP 199.01
	East of Sharon	1 & 2	MP 212.30	MP 212.42
NYD		1 & 2	Pole 206-H	Pole 204-H
		1 & 2	Pole C-66	C-70

Table 5 – DEAD SECTIONS

Location	Tracks	Catenary Br or Signal Br	Distance of Break
PW Line	1 & 2	Cat. Br 58.68	200 feet Northward & Southward
	3 & 4		
PH Line	1 & 2	Cat. Br 33.78	360 feet Eastward & Westward
	3 & 4	Cat. Br 33.71	

Table 6 –PHASE BREAKS

In service on track	Governs track(s)	For direction	Location of Indicator	Distance from Phase Break
PW Line: Perry				
1	1	North & South	Northward trains:	1425 feet
2	2		Sig. Br. 590	1425 feet
3	3		Southward trains:	1425 feet
4	4		Coudon's Rd. OHB, MP 58.34	1425 feet
PH Line: Thorndale Substation				
1	1 & 2	East	Eastward trains: Cat. Br. 34.15	1925 feet
3	3 & 4	East		1925 feet
1	1 & 2	West	Westward trains: Cat. Br. 33.39	1900 feet
4	3 & 4	West		1900 feet

Table 7 – POSITION LIGHT PHASE BREAK INDICATORS

## 2.3 PANTOGRAPH OPERATIONS

**2.301** Under normal operation of single or coupled electric locomotives the trailing pantograph must be up on each unit. When a trailing pantograph is defective, it must be down and the lead pantograph must be up. HST Type I must be operated with the pantograph knuckles facing forward on both power cars for the direction of movement. On a HST, when a pantograph with the knuckle facing forward is defective, it will be down and the pantograph with the rearward facing knuckle will be up.

**2.302** Under normal operations, trains in push-pull service operating over 100 MPH will operate with pantograph knuckle facing forward.

**2.303** An electric locomotive or HST power car must not be operated with both pantographs raised, except when directed by Train Dispatcher. HST Engineers who receive a Double Pantograph instruction must raise both pantographs on the lead power car only (Pantograph configuration of rear power car will not be affected). Train Dispatcher must confer with Power Director before issuing Double Pantograph Instruction.

**2.304** When units of equipment are coupled, only one of the adjacent pantographs at the coupled ends should be up. The number of electric locomotives coupled and in service will be governed as outlined in AMT-2 3.102.

**2.305** Any electric equipment with an MCB must have the MCB opened prior to changing configuration of the pantograph, unless authorized by the equipment instruction manual to allow for simultaneous contact with the catenary.

**2.306** Any electric equipment without an MCB will not change configuration of the pantograph(s) at the locations listed below until Power Director has been advised and power has been removed:

- New York Division - Between west portal of Hudson (North) River Tunnels and east portal of East River Tunnels.
- Mid-Atlantic Division, Harrisburg Station - Pantographs must not be dropped while on Station tracks Nos. 4, 5, 6, 7, and 8, inclusive, nor at Lancaster Station while under passenger bridge, or under other close overhead structures, except in case of emergency.
- Philadelphia, 30th Street Station - Pantographs must not be dropped or raised while on Station tracks at 30th Street, except in case of emergency.
- Baltimore - Pantographs must not be dropped on Station platform Tracks No. 1 through 7 inclusive, Track No. 1, 2, and 3 Union Tunnels, Track No. 2 and 3 B&P Tunnel, and between Howard Street and Guilford Avenue, except in case of emergency.

**2.307** Stopping electric equipment with pantographs up in section breaks is prohibited.

**2.308** On electric equipment hauled "dead in tow" because of defective or damaged pantograph:

The pantograph must be secured with no part extending above the latched down position (14'-8"). All pantograph-grounding switches will be in the OPEN position.

Note: Any damaged pantograph found in route to New York must be inspected by a qualified Electric Traction Department Employee prior to proceeding toward the tunnels into New York.

**2.309** Electric equipment must not be moved until all broken pantographs have been removed, secured, and/or properly isolated.

**2.310** The Train Dispatcher may issue a Drop Pantograph Instruction Form D under the direction of field supervision that has determined it is safe to do so. The Form D will indicate tracks involved and limits of territory through which pantographs must be kept down. The Form D will be issued when:

- A. There is catenary damage or an obstruction that may impact the pantograph.
- B. It has been determined that electric equipment can be safely operated under such catenary with pantographs down by an ET employee in the field.
- C. Prior to entering the limits specified in the Drop Pantograph Instruction, all pantographs will be tested. When any pantograph fails to operate properly, or Drop Pantograph Instruction cannot be complied with, the equipment will be stopped immediately and condition reported to the Train Dispatcher.
- D. Electric equipment will not exceed speed of 30 MPH within the limits specified, unless otherwise stated in the Drop Pantograph Instruction Form D.
- E. The pantograph DOWN button will be left in the DOWN position between the limits specified in Drop Pantograph Instruction Form D.

**2.311** When electric equipment is derailed, it must be considered energized. Engineer must drop all pantographs immediately. Crew members must not permit passengers or Employees from boarding or exiting the equipment until the pantographs are lowered and the overhead wire is de-energized, tested de-energized, and grounded. Crew members must not exit the electric equipment in a manner which permits simultaneous contact with the equipment and earth and must prevent anyone else from doing so.

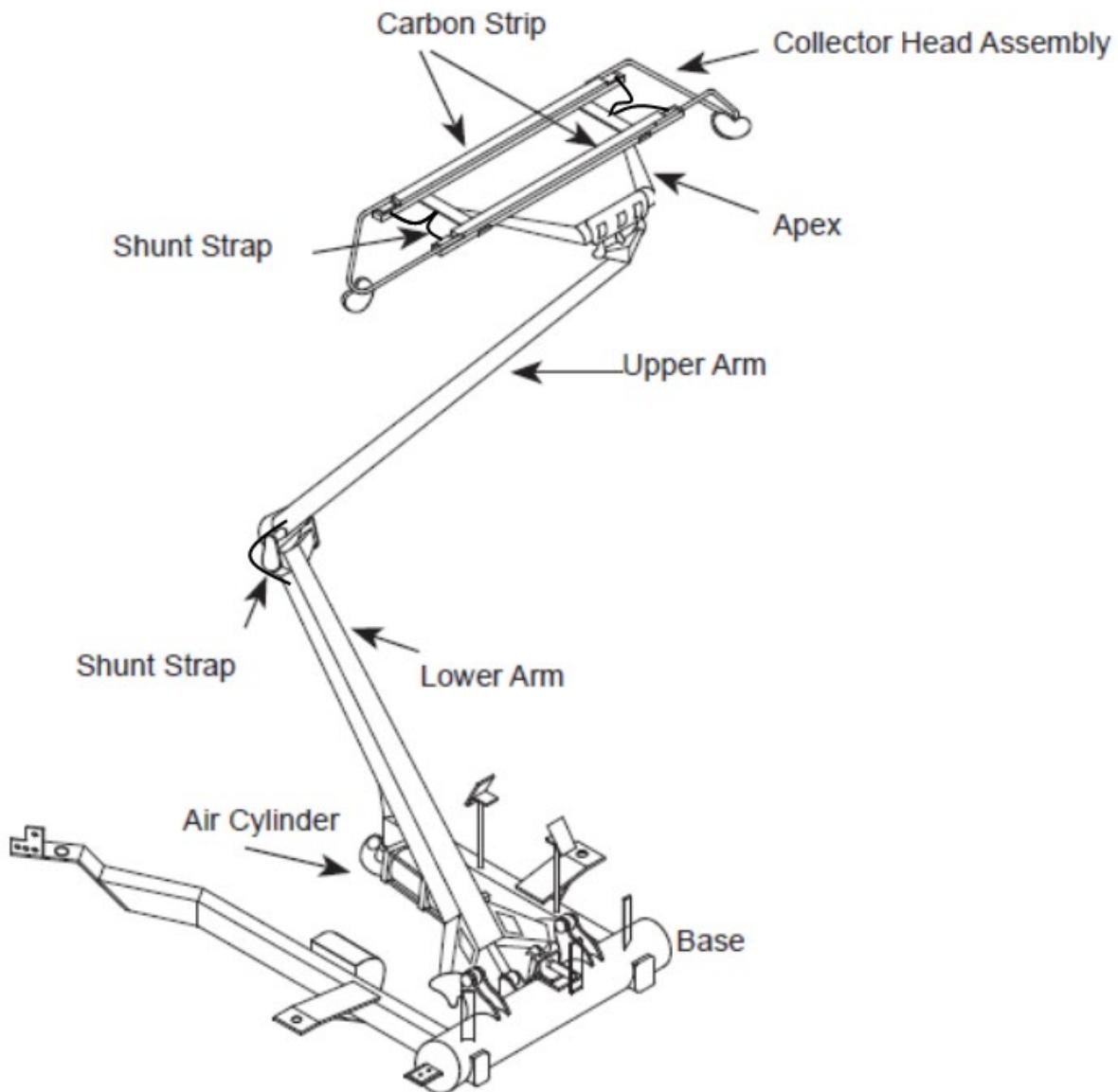


Figure 17 - PANTOGRAPH

## **2.4 CATENARY OR THIRD RAIL POWER OUTAGES**

**2.401** When a catenary or third rail power outage occurs, the Power Director shall notify the Train Dispatcher or Employee having jurisdiction over track(s) of the power outage limits and affected tracks.

**2.402** After a catenary power outage, when two or more electric trains stop on the same track between the same two interlockings, the following train should not start until the preceding train has been moving for 30 seconds.

**2.403** When a catenary power outage occurs and power is restored on the first attempt, train(s) within the affected catenary circuit must be instructed to proceed at normal speed to the next scheduled station stop to inspect pantographs.

**2.404** When a catenary power outage occurs and power cannot be restored on the first attempt, train(s) within the affected catenary circuit must be instructed to stop and examine pantographs for damage, unless the cause of the outage has already been determined.

**2.405** Results of pantograph inspections must be reported to the Train Dispatcher and relayed to the Power Director.

- A. If pantograph damage is found, follow the instructions described in 'Pantograph Damage' in AMT-2 2.5.
- B. If no pantograph damage is found, the Train Dispatcher must direct the all trains moving through the area to perform an inspection in accordance with AMT-2 2.6.

## **2.5 PANTOGRAPH DAMAGE**

**2.501** When Carbon Strip Damage occurs:

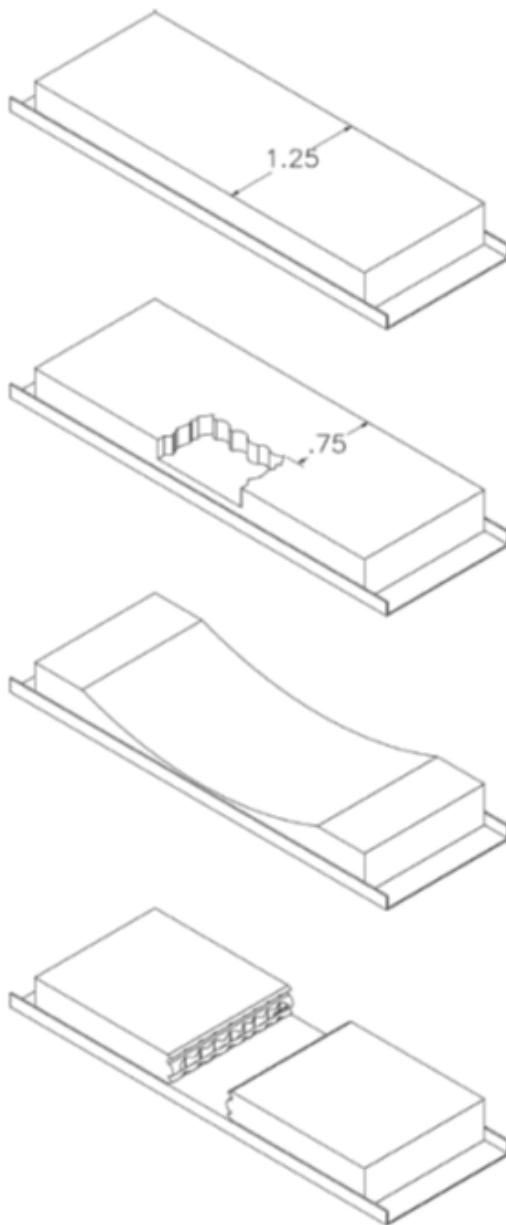
- A. The Engineer will inform the Train Dispatcher the status of the pantograph and reconfigure pantograph if possible.
- B. Train Dispatcher will provide the Power Director the route of the equipment since last pantograph inspection and any additional information requested.
- C. Train Dispatcher will direct an inspection be performed in accordance with AMT-2 2.6 on any tracks used by the engine since last pantograph inspection.

**2.502** When a pantograph Auto Drop/Broken Pantograph or Carbon Alarm occurs Engineer will:

- A. Notify the Train Dispatcher
- B. Inspect pantographs and report findings to Train Dispatcher
- C. Reconfigure pantographs if possible, inform Train Dispatcher, and await his instructions

**2.503** If a train is stopped with pantograph damage other than Carbon Strip Damage, the Train Dispatcher must immediately:

- A. Determine the type of damage sustained and the location of the train
- B. Notify the Power Director
- C. Direct an inspection be performed in accordance with AMT-2 2.6 on all tracks 5 miles to the rear of the train



**New Carbon Strip**

**Chipped Carbon** – Adequate for service if more than 3/4" of flat surface remains. If less than 3/4" remains, remove from service immediately and notify Train Dispatcher.

**Worn Carbon** – Renew on daily inspection if less than 1/8" to the metal channel.

**Broken Carbon** – Remove from service and immediately notify Train Dispatcher and Power Director.

Figure 18 - CARBON STRIP INSPECTION

## 2.6 INSPECTING FOR CATENARY OR THIRD RAIL DAMAGE

**2.601** When an infrastructure inspection is required, the Train Dispatcher must not permit trains to enter the affected area without receiving instructions to inspect for damage at the speeds shown in Table 8.

Reason for Inspection	Track(s) Inspection Required	Inspection Speed*
AC or DC power outage with unknown cause, power restored on the first attempt	Affected Track(s)	Normal Speed
AC power outage with unknown cause, power <u>not</u> restored on the first attempt	All Tracks through the affected area	30 MPH Prepared to drop pantograph
DC power outage with unknown cause, power <u>not</u> restored on the first attempt	All Tracks through the affected area	Restricted Speed
Train reported with carbon strip damage	Tracks used by engine since last pantograph inspection	Normal Speed
Train reported with damage other than carbon strip damage	All tracks 5 miles to rear of train	30 MPH Prepared to drop pantograph

\* Power Directors may direct Train Dispatchers or Operators to inspect at slower speeds, if necessary, to ensure thorough inspection.

Table 8 - CATENARY OR THIRD RAIL INSPECTIONS

**2.602** When instructed to inspect for catenary damage, trains must:

- Inspect the catenary for defects on the track they are operating (or an adjacent track if so instructed) within the limits specified.
- Operate at an inspection speed of 30 MPH unless otherwise directed by the Train Dispatcher. When operating at 30 MPH always be prepared to drop pantographs.
- Report the results of their inspection to the Train Dispatcher or Operator when clear of the specified limits.

**2.603** When instructed to inspect for third rail damage, trains must:

- Inspect the third rail infrastructure for defects on the track they are operating (or an adjacent track if so instructed) within the limits specified.
- Report the results of their inspection to the Train Dispatcher or Operator when clear of the specified limits.

**2.604** Results of infrastructure inspections must be relayed to the Power Director by the Train Dispatcher.

**2.605** Power Directors may waive the requirement for trains to inspect the catenary or third rail if a Class "A" Employee has performed a visual inspection of the affected area from the right of way.

**2.606** Infrastructure inspections directed by the Train Dispatcher are to remain in effect until a train has performed a complete inspection and either the cause of the power outage has been determined or the train reported "no exceptions taken" on the affected track(s). The Train Dispatcher/Power Director may require additional inspections depending on the circumstances of the outage.

## 2.7 SLEET/EXTREME WEATHER INSTRUCTIONS

### 2.701 Sleet Instructions

- A. When sleet formation on the pantograph or catenary system causes excessive arcing, the Engineer/Employee shall promptly report the condition to the Train Dispatcher/Power Director. Train Dispatcher will verbally issue a Double Pantograph Instruction on a train by train basis. Engineers will inform the Train Dispatchers of the sleet conditions and when it is determined that sleet conditions no longer exist, the Train Dispatcher will remove the double pantograph order and Engineer will resume normal pantograph configuration at next station stop.
- B. The Train Dispatcher will notify the Power Director when issuing and removing a Double Pantograph Instruction.
- C. With double pantograph instruction in effect, electric equipment operating individually shall run with both pantographs up, except through PB (when lit) and DS. Drop all pantographs prior to entering the PB and DS.
- D. Multiple Electric Engines coupled shall run with both pantographs up on the leading unit and rear pantograph up on each trailing unit except through phase breaks (when lit). Drop all pantographs prior to entering the PB and DS.
- E. Electric Equipment in yards, storage tracks, or standing at any point, should have pantographs lowered and raised frequently to prevent accumulation of sleet. Electric equipment left unattended shall have pantographs lowered to prevent arcing caused by sleet formation.
- F. When a pantograph lowers due to sleet, or when sleet load on a pantograph becomes excessive resulting in heavy arcing between shoe and wire, open the MCB and attempt to raise and lower the pantograph several times. If this fails, the Train Dispatcher must be advised and arrangements made to de-energize, test de-energize, and ground catenary before sleet can be removed.
- G. During sleet storms, pantographs must be inspected frequently and at the end of each trip.



Figure 19 - DOUBLE PANTOGRAPHS

**2.702** During periods of extreme weather where sustained wind speeds above 50 MPH are encountered, electric trains must be instructed to operate at a reduced speed of 60 MPH and be on the lookout for debris in the catenary or right of way.

- If sustained wind speeds in excess of 60 MPH are encountered, then the train must reduce speed to 60 MPH and proceed to the nearest terminal and stop until wind speeds fall below 60 MPH.
- The limits of the restriction will be provided to the Movement Office by the Deputy Chief Engineer – ET or his designated representative. Train Dispatchers will issue Form D or Temporary Speed Restriction Bulletin additions placing the above restrictions in effect.

**2.703** During periods of extreme high or low temperatures, extra precautions must be taken by making additional inspections to determine that both the catenary and the third rail systems are in proper condition, free of obstructions or broken hardware.

## **2.8 ELECTRIC POWER RESTRICTIONS**

**2.801** When the Load Dispatcher determines a reduction in power consumption is necessary, the Load Dispatcher will inform the Power Director of the limits of the restriction. The Power Director will inform the Train Dispatcher of the limits of the Power Restrictions. The Power Restrictions can be found in the table below:

Equipment	Controller Position/Power Effort Must not Exceed:	Notes
HST Type I Power cars	50,000 foot pounds	...
HHP-8 Engines	50,000 foot pounds	...
AEM-7 (AC) Engines	7,500 foot pounds per traction motor	...
AEM-7 (DC) Engines	1,500 Amps	...
ALP-44 Engines	1,500 Amps	...
ALP-45 Engines	1,500 Amps	1, 2
ACS-64	50,000 foot pounds	
ALP-46 Engines	1,500 Amps	1
MU Cars	P-2 Position	...

Note 1: Total line amperage can be viewed on ITU Propulsion Screen.  
Note 2: This notching restriction only applies when this engine is operating in electric mode.

Table 9 - ELECTRIC POWER REQUIREMENT RESTRICTIONS

This restriction will be issued verbally or by Form D and will remain in effect until it is cancelled by Train Dispatcher (or Operator when authorized by the Train Dispatcher).

## **2.9 PLATE ORDER PROCESS**

**2.901** All communication between the Train Dispatcher or Employee having jurisdiction over the affected track(s) and the Power Director regarding the Plate Order process will be conducted on a recorded line using three-part communication.

**2.902** Plate Order form NRPC-2990 will be utilized for the Plate Order process when electronic means are not available.

**2.903** When required to remove track(s) from service for electric operation, the Power Director will determine the proper power sectionalizing and Plate Order(s) necessary.

**2.904** Train Dispatchers and Employees having jurisdiction over track(s) must:

- A. Possess the necessary qualifications to issue Plate Orders and ensure that protection is properly applied.
- B. Ensure and record that the proper blocking is in place to properly protect the affected track(s) prior to issuing the Plate Order.
- C. Ensure that non-interlocked hand-operated switches are lined and locked (away from the affected track(s)) and tagged in the name of the person having jurisdiction over the affected track(s) prior to issuing the Plate Order.
- D. Direct and record the temporary removal of blocking or the lining of affected switches to allow equipment unrestricted by the Plate Order to move within the area affected (when required).
- E. Direct, record, and ensure the reapplication or blocking or the lining, locking and tagging of affected switches after the move has been completed to re-establish the Plate Order protection.
- F. Ensure that all electric equipment equipped with Pantographs be lowered and locked and/or no third rail shoes are in contact with the third rail in the area affected by the plate. When the pantograph or third rail shoe cannot be retracted, the Main Circuit Breaker on the train must be opened and tagged.

**2.905** When requesting a Plate Order, the Power Director must specify the plate number and page number for the required Plate Order.

**2.906** In the event of an emergency, the Power Director will notify the Train Dispatcher or Employee having jurisdiction over the affected track(s) and identify the type and limits of the required protections.

- A. The Power Director will direct the Train Dispatcher or Employee having jurisdiction over the affected track(s) to apply either an Emergency Plate Order or an AC, DC, or Solid Hold over the affected tracks.
- B. The Train Dispatcher will apply blocking devices.
- C. Other employees having jurisdiction over the affected track(s) will hold trains clear of the affected tracks.

**2.907** All Plate Orders must be properly protected prior to being issued, except for Emergency Plate Orders. The only appropriate methods for protecting against electric movements are applying a blocking device, displaying a stop signal, or lining, locking and tagging a switch away from the affected tracks.

**2.908** The Power Director must request and receive plate protection from the Train Dispatcher, or Employee having jurisdiction over the affected tracks(s), prior to removing power.

**2.909** The Power Director must notify the Train Dispatcher or person having jurisdiction over the affected track(s) when the Plate Order can be annulled.

**2.910** Controlled Track

- A. Should multiple Employees have jurisdiction over portions of the affected tracks, all must participate in the Plate Order process and ensure adequate protection prior to issuing the Plate Order.
- B. The Train Dispatcher or Employee having jurisdiction over the affected tracks must determine if the Plate Order requested can be issued and apply all necessary Plate Order protection. Once completed, the Plate Order request can be approved.
- C. Block Operators will be governed by the power sectionalizing plate in effect, holding trains as needed under direction of the Train Dispatcher.
- D. The Employee who has jurisdiction over the affected tracks, must ensure no pantographs are raised or no third rail shoes are lowered within the limits of the Plate Order while it is in effect. When the pantograph or third rail shoe cannot be retracted, the Main Circuit Breaker on the train must be opened and tagged.

**2.911** Non-Controlled Track – Should no Employee have jurisdiction over the affected tracks, the Train Dispatcher will issue a Plate Order to the Power Director for the controlled tracks providing access to the requested non-controlled track in accordance with AMT-2 2.904. Do Not Operate Tags must be placed on all Electric Engines within the plate order limits by the Employee having jurisdiction over the equipment. All applied tags must be reported to the Train Dispatcher.

**2.912** DTMF Radio Controlled Track Switches – Should DTMF switches be required for use as blocking points, local control must be taken by a C&S Employee prior to the switch being lined, locked, and tagged.

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### 3. RULES AND INSTRUCTIONS PERTAINING TO MECHANICAL ACTIVITIES

#### 3.1 ELECTRIC ENGINE

3.101 The operation of more than two (2) electric locomotives, except MU cars, in a train is prohibited. When there are more than two electric locomotives in the consist, the remaining units will not provide traction power. AEM-7-DC units will be live-in-tow, unless defective. HHP-8 units, ACS-64 units, and High Speed Trainsets will be dead-in-tow (pantograph(s) down) with 480 V power to locomotive(s) or train. Locomotives or trainsets in tow must be moved as follows:

- A. AEM-7-DC Units: Pantograph is to be up, unless damaged. 27-Point MU cables and 480 V cables must be connected between units. Brake pipe, main reservoir, and all MU hoses must be connected. Main circuit breaker is to be closed. HEP and APL converters are to be switched off, and traction power is to be "isolated". Traction motors should not be cut out.
- B. ACS-64 Units: Pantograph(s) must be down. 27-Point MU cable and 480 V cables must be connected between units. Brake pipe, main reservoir, and all MU hoses must be connected. The HEP control switch should be set to HEP line. The emergency magnet valve must be cut out.
- C. HHP-8 Units: Pantograph(s) must be down. 27-Point MU cables and 480 V cables must be connected between units. Brake pipe, main reservoir, and all MU hoses must be connected. The emergency magnet valve must be set to "IN", and the pantograph selector must be set to "OFF".
- D. High Speed Trainsets: HST must not be coupled together. When a locomotive tows a HST, pantographs must be down, and 480 V cables must be connected between locomotive and trainset. Main reservoir and brake pipe must be coupled. The emergency magnet valve must be set to "IN", and both power cars must have pantograph selector set to "OFF".

**Note:** When making light electric engine moves, while pantographs are up, between Ivy City and Washington Terminal the following will apply:

- A. A maximum of six electric engines will be allowed in a consist.
- B. The 27 point MU cable requirement listed in AMT-2 3.101, is not required. When handling more than three engines, operating speed must not exceed 15 MPH.

3.102 The maximum number of Electric MU cars are as follows:

New York to Washington, D.C.	12
Philadelphia to Harrisburg	10
ConnDOT M8	8

3.103 Electric engines may only be plugged into wayside power stations after pantographs are lowered. Pantographs may not be raised until wayside power is removed.

3.104 When necessary to inspect or test single or coupled energized electric engines or MU cars, a Class "B" Employee must take charge. Others assisting with such work must be governed by the Class "B" Employee's instructions.

**3.105** Repair work on or near main power circuits on electric engines or MU cars must not be performed under energized (LIVE) wire until pantographs have been lowered, grounding switches have been closed, and standard tags have been applied by the Class "A" or "B" Employee in charge. Other Employees performing this work must obtain permission from a Class "A" or "B" Employee before starting work and must advise the Class "A" or "B" Employee when work is completed. Mechanical warning tags must be removed by the Class "B" Employee who applied them. Grounding switches must not be opened until tags are removed and it is known that all persons are clear of main power circuits.

(Do Not Operate Tags (NEC-105) must be removed according to these instructions.)

### **3.2    *FACILITIES EQUIPPED WITH CATENARY ISOLATION DEVICES***

- 3.201** Work must not be done on the roof of locomotives, MU cars, or equipment under overhead wires, except as permitted by these instructions, and then only by or under the supervision of a Class "A" or "B" Employee.
- 3.202** All terminals, service and inspection locations equipped with catenary isolation systems must have a documented site specific procedure for safe operation. Procedures must be approved by the Deputy Chief Engineer – ET or his designated representative.
- 3.203** All Class "B" Employees must be familiar with the catenary isolation procedures governing their work location.
- 3.204** Inspection and repair work on electric equipment under overhead wires will be performed in accordance with the written procedure of that location's catenary isolation systems.
- 3.205** Pantographs must not be raised until it is known that all persons, tools, and equipment in the vicinity of the electric equipment are clear of all circuits and it is understood that the equipment is to be energized.
- 3.206** Class "B" Employees cannot use catenary isolation systems as electrical protection for any personnel other than Class "B" Employees.

#### 4. RULES AND INSTRUCTIONS PERTAINING TO ELECTRIC TRACTION ACTIVITIES

**4.101** Authorized and qualified Employees who work on or about an electric circuit, apparatus, or equipment must have full knowledge of its operating voltage and application.

**4.102** While on duty, qualified Class "A" Employees must have in their possession a copy of all applicable schematics or prints of the work zone, the Electrical Operating Rules and Instructions (AMT-2), Standard Operating Instructions (SOI), and RWP manual.

**4.103** When reporting for duty, the Person in Charge must advise the Power Director of personnel working in the assigned territory and any planned work.

**4.104** The Power Director must be advised of any alarms or abnormal conditions promptly.

**4.105** The Person in Charge will ensure a documented "ET Job Briefing" (NRPC 3044ET) is conducted. When working on or near tracks, with or without equipment, an "On Track Briefing" is required in addition to an "ET Job Briefing". When the work requires working at heights, an "Engineering Fall Protection Job Briefing" must be conducted using (NRPC 3418).

**4.106** It is the responsibility of the Person in Charge to ensure that all workers understand all aspects of the ET Job Briefing. The Class "A" Employee has the authority to stop all work in the protected area if anyone in the group does not understand or comply with his instructions.

**4.107** The Class "A" Employee who is obtaining the clearance in accordance with SOI 211, "Electrical Clearance Procedure" must:

- A. Understand and establish the limits of protection to ensure the electrical hazard will be removed from the worksite.
- B. Perform or direct switching and tag application as directed by the Power Director to ensure the work site is de-energized.
- C. Test de-energized or direct other Employees to test de-energized in accordance with SOI 203, "Voltage Testing and Verification Plan".
- D. When working with equipment fitted with a grounding pantograph, direct its raising and verify contact with catenary. This must be done prior to anyone ascending to the top of the equipment.
- E. Direct the application of required temporary protective grounds. All work must be performed between grounds, except as governed by these instructions. Grounds must be placed in plain view of the work area when possible.
- F. Explain to all persons involved the designation of the circuit/apparatus de-energized and the limits of the clearance. Obtain printed names/signatures indicating their understanding of the clearance and authorized work area.
- G. Observe the movements of all personnel under his protection and/or assign a Class "A" Employee to protect personnel not within his immediate vision.
- H. When work is completed. Class "A" will ensure all personnel and equipment are clear of all circuits/apparatus. Explain to all personnel the clearance is to be released. Obtain printed names/signatures indicating their understanding.
- I. Direct the removal of temporary protective grounds.
- J. When working with equipment fitted with a grounding pantograph, confirm it has been lowered and locked.
- K. Perform or direct switching and tag removal as directed by the Power Director.

- 4.108** Under no circumstances will any switching be performed except in accordance with instructions given by the Power Director and only by Employees who are qualified and authorized.
- 4.109** All ET Personnel must wear appropriate FR rated clothing while at work, in accordance with SOI 201, "Arc Flash Protection Program".
- 4.110** All ET Personnel must wear gloves rated at 1000V while working on circuits that remain energized between 150V and 480V unless properly de-energized and grounded.
- 4.111** The Class "A" Employee providing protection must place himself in a position which will permit close observation of all locations within proximity to the energized wires and from which he can best observe the movement of all personnel toward such locations.
- 4.112** The Class "A" Employee providing protection to contractors, Class "B" or "C" Employees must not engage in any work himself, nor shall he converse with the men or foreman, any more than is necessary to convey to them the instructions he has to give them.
- 4.113** The Class "A" Employee providing protection will, under no condition, assume that the personnel who have been instructed by him will adhere strictly to such instructions, but will remain alert to detect any potential violations of those instructions.
- 4.114** Class "A" employees must fill in the appropriate fields on Clearance Form NEC-260 and Work Permit form NEC-261. Information on the forms must be legible and only utilize a single strike through to omit errors.
- 4.115** All work-related matters between Electric Traction Employees and the Power Director will be conducted on a recorded line using three-part communication when required.
- 4.116** Employees must identify themselves when calling the Power Director.
- 4.117** Any electrical equipment found to be not operating as intended or available for service must be reported to the Power Director, tagged out of service, and tracked for repair.
- 4.118** ET Trainees will not be the first person allowed to ascend, or be the last person to descend from, the top of equipment, except single person buckets. In this scenario they must be continually visually observed by a Class "A" Employee. These situations must be discussed and noted on the Job Briefing.
- 4.119** Rotary signal machines will continue to generate power until the rotating machinery has stopped. Be aware of both electrical and mechanical energy.
- 4.120** Exercise care when there is a transformer connected to equipment de-energized for maintenance or repairs. Ensure that there is no possibility of back feed.
- 4.121** Apply and remove temporary protective grounds only when authorized to do so by Class "A" Employee who obtained the clearance.
- 4.122** Do Not Operate Tags (NEC-105) and blocking devices will not be removed except as instructed by the Power Director. Employee will complete removed tags as follows (See Figure 20):
  - A. Time and date tag is removed.
  - B. Name of Employee that removed tag.
  - C. Operation and time will be reported promptly to the Power Director.



Figure 20 - DO NOT OPERATE TAG (NEC 105)

**4.123** Do Not Operate Tags (NEC-105) must be filled out completely and accurately including information detailing the reason for placing the equipment out of service. Before removing or directing the removal of Do Not Operate Tags (NEC-105), make thorough check to ensure that all personnel, equipment, and tools are in the clear of the circuits involved and have received proper notification that grounds have been removed. Do Not Operate tags must not be removed from switch without the authority of the Person in Charge or the Power Director.

**4.124** All Do Not Operate Tags (NEC-105), which have been used as outlined in the foregoing, will be forwarded to the Assistant Division Engineer – ET.

**4.125** When working under a clearance, and it becomes necessary to work in close proximity to energized wires, this work shall be personally supervised by the Class "A" Employee holding the clearance, or his designee. This Employee must take precautions necessary to prevent tools, apparatus or other personnel from approaching within the MINIMUM APPROACH DISTANCE.

**4.126** Under no circumstances may other than Class "A" Employees or Class "A" ET trainees under the direction of a qualified Class "A" Employee be permitted to approach within three (3) feet of energized catenary.

**4.127** When it appears work cannot be completed in the time allotted, the Power Director must be notified as soon as possible.

**4.128** When work is to be performed on railroad transmission circuits, the transmission circuits of the railroad and utility occupations will be de-energized and grounded. If the utility company's transmission circuit cannot be de-energized and grounded, MINIMUM APPROACH DISTANCE must be maintained. (See Tables 1 & 2)

**4.129** Approved hot line tools may only be used on circuits energized at 25,000 volts or less, unless ground switches have already been visually verified.

**4.130** Hot Line tools must be inspected for defects prior to use and must have a valid inspection sticker.

**4.2 RUBBER GLOVES AND RUBBER MATS**

**4.201** With the exception of working directly on energized third rail where rubber gloves must be used, Employees will use rubber gloves consistent with AMT-2 rules and instructions.

**4.202** Rubber gloves will not be used without leather gauntlets.

**4.203** Rubber mats are only to be used to prevent accidental contact with energized circuits or equipment. Rubber gloves with leather gauntlets are the only rubber product designed for Employees to come into continuous contact with energized circuits or equipment.

**4.204** Leather gauntlets will not be used for any other purpose. When leather becomes wet, remove it from the rubber glove until thoroughly dry.

**4.205** Remove oil from hands before using rubber gloves.

**4.206** Leather gauntlets will not be used as rubber glove protectors if:

- A. Worn thin, worn through, or torn
- B. Hardened from being wet
- C. Having open seams
- D. Having embedded wire or wood splinters
- E. Soaked in oil or covered in grease

**4.207** Before using rubber gloves, perform a careful visual inspection and air test.

**4.208** Before using rubber mats, roll each side of the mat two (2) times so that each rolling will be at right angles to each other.

**4.209** Rubber gloves and rubber mats will not be used if by inspection the following are found:

- A. Cuts or cracks
- B. Deep scratches
- C. Punctures
- D. Embedded foreign materials
- E. Oil markings
- F. Gloves that leak air.

**4.210** Do not use rubber gloves beyond 6 months of the date they were last tested.

**4.211** Do not use rubber gloves that are not stamped with the appropriate proof tested AC voltage followed by, tested by: \_\_\_\_\_, date \_\_\_\_\_, size \_\_\_\_\_.

**4.212** Do not use rubber mats beyond 1 year of the date they were last tested.

**4.213** Do not use rubber mats that are not marked with the appropriate proof test followed by, tested by: \_\_\_\_\_, date: \_\_\_\_\_.

**4.214** Employee reserve the right to request another pair of rubber gloves or rubber mat if he feels they are unsafe.

**4.215** When not in use, keep rubber gloves and leather gauntlets in suitable glove bag or box as follows:

- A. Only one pair per bag or box is allowed.
- B. Do not store gloves inside out.
- C. Do not unnecessarily expose gloves to sunlight, oil, or heat.

**4.216** Mats will be stored in manufacturer approved mat canisters or mat roll-ups and as follows:

- A. Do not fold mats.
- B. Do not place any object on top of mats.

#### **4.3 GROUNDING**

- 4.301** Before performing any work on a circuit or apparatus, it must be de-energized and tested de-energized with an approved testing device and grounded.
- 4.302** When uncertain about how to adequately ground, questions must be elevated through the Employee's chain of command up to and including the ET Engineering Department.
- 4.303** Test de-energized at the same location grounds will be applied.
- 4.304** All grounding equipment, sticks, cables, and clamps must be inspected prior to each use. Should any defect be found, the equipment must be removed from service and a Do Not Operate Tag (NEC 105) applied.
- 4.305** Temporary protective grounds must first be attached to ground and then secured to the line or equipment to be worked on. When removing grounds, they must first be disconnected from the line or equipment before removing them from the ground connection.
- 4.306** Always ensure catenary structure or signal bridge is properly bonded prior to attaching temporary protective grounds.
- 4.307** Always ensure ground connections are properly tightened.
- 4.308** Rubber gloves and leather gauntlets must always be worn while testing de-energized.
- 4.309** No lines or equipment may be grounded without first receiving a clearance from the Power Director.
- 4.310** Before applying temporary protective grounds from an overtrack structure or signal bridge, test or re-test the line de-energized after in position on the structure.
- 4.311** Ground stick must be applied so that it will not foul pantograph of train on adjacent track.
- 4.312** Ground cables must be positioned and secured to prevent injury in the event they are energized with fault current.
- 4.313** Before applying temporary protective grounds to railroad transmission circuits, make a visual check to be sure that grounding switch has made contact in at least one adjoining substation and in both substations if the circuit is parted. Visual confirmation must be reported to the Power Director prior to receiving clearance.
- 4.314** All work must be performed between temporary protective grounds unless working on an insulator between a grounded structure and a circuit. When working on a section insulator or other in-span insulator, only one temporary protective ground on either side of the insulator is necessary.
- 4.315** When multiple circuits are being worked on, each circuit must be independently grounded unless jumpers have been applied or switches have been arranged to maintain electrical continuity between circuits.
- 4.316** When hand operated switches must be closed for ground continuity after a clearance has been issued, they must be checked closed, locked closed and a Do Not Operate Tag (NEC 105) applied.

**4.317** When motor operated disconnects must be closed for ground continuity after a clearance has been issued, they must be checked closed, locked closed, a Do Not Operate Tag (NEC 105) applied, and control power removed or disabled.

**4.318** When working directly on de-energized catenary, one temporary protective ground must be applied as close as is practical and always within eyesight.

**4.319** Relying on a temporary protective ground that is separated from the worksite by a circuit breaker, switchgear immersed in oil, or similar device, is prohibited unless working under a grounding procedure approved by ET Engineering.

**4.320** All grounding equipment that is involved in a fault must be immediately removed from service, visually inspected, and electrically tested before returning to service.

#### **4.4 CONTROL HOUSES AND RTU HUTS**

**4.401** Modification of relays or other protection devices will only occur under the direction of ET Engineering.

**4.402** Upon entering a control house or frequency converter, Employees will:

- A. Visually check indications on the control boards.
- B. Depress ground lamp button (when equipped) and note any difference in the brightness of the ground lamps. Depress Lamp Test Button (when equipped) and observe lamps for burnt out bulbs and replace bulbs when applicable.
- C. Note readings on voltmeter and other indicating meters.
- D. Report any relay targets to the Power Director or Load Dispatcher prior to resetting.
- E. Any abnormal condition noted at this time or during the work shift must be reported immediately to the Power Director or Load Dispatcher.

**4.403** On a control switch, a red light denotes the closed position and a green light denotes the open position. When handle of the control switch is in locked-out position, there is no light indication. On a control switch equipped with a mechanical target, the color of the target indicates the position to which the control switch was last operated and does not necessarily denote position of the apparatus. When operating control switches in accordance with instructions from the Power Director:

- A. The Employee must repeat instructions as given, and then perform operations in the order received.
- B. The Employee must open control switch, lock out the handle, and apply blocking device with Do Not Operate Tag (NEC 105) completed as follows:
  1. Name or number of apparatus
  2. Number of clearance on which work is to be done
  3. Name of person in charge
  4. Signature of Employee placing tag
  5. Time and date tag is placed
  6. Location
- C. Employee must then report the operations to the Power Director who will verbally repeat or correct the operations reported.
- D. Any control handle removed from service, must be reported to the Power Director and have a Do Not Operate Tag (NEC-105) applied.

- 4.404** To close apparatus, the control handle must be held in closed position approximately three (3) seconds. When red light indication is obtained, apparatus is closed, control handle will be restored to the neutral position and completion of instruction will be reported to the Power Director. When red light indication is not obtained, condition must be reported immediately to Power Director.
- 4.405** To open apparatus, the control handle must be held in open position approximately three (3) seconds. Unless otherwise instructed by Power Director, handle will be restored to neutral position to observe green light indication.
- 4.406** When apparatus opens automatically, as indicated by alarm bell ringing and light indication changing from red to green, or transformer temperature alarm sounds, Employee will immediately notify the Power Director and follow his instructions.
- 4.407** Prior to placing Current Transformer (CT) circuits in service, they shall be ratio tested and have shorting blocks removed.
- 4.408** The Load Dispatcher or Power Director will be notified prior to beginning maintenance on any battery system for converter facilities or substations, respectively.
- 4.409** Battery rooms present a significant hazard for electric shock, arc flash, and burns. Precautions must be taken to protect against electrical and chemical hazards.
- 4.410** There is no smoking, open flame, or spark permitted in any battery room.
- 4.411** Care must be exercised when entering a battery room, making sure ventilation is present to prevent build-up of explosive gases.
- 4.412** Gloves rated at 1000V shall be worn when disconnecting, connecting, or testing batteries.
- 4.413** Jewelry or exposed conductive materials shall be removed while working on or around batteries.
- 4.414** Employees shall always pour acid into water to prevent an exothermic reaction and the liquid exploding when preparing electrolyte for batteries. Employees shall wear protective goggles, face shield, and protective apron when handling any harmful fluids.
- 4.415** Do not allow any object or tool to ground or short between battery terminals. Never use batteries as a work surface.

#### **4.5 Catenary Work**

- 4.501** Ground that portion of steady span located between other circuits before disconnecting it from trolley and auxiliary wire.
- 4.502** When necessary to ground catenary circuit, place ground on auxiliary wire, trolley wire, or messenger wire in that order of preference.
- 4.503** When cutting or parting wire, secure ends to avoid injury from sudden release of tension and wire returning to its spooled position.
- 4.504** On curve or corner, when pulling wire, cable, or rope into position, or when releasing it from position, Employees must keep to the outer side of the curve, if practical.
- 4.505** When renewing catenary wire on a curve, secure new wire to old wire at each hanger location to prevent wire from fouling train on adjacent track.
- 4.506** Securely fasten catenary or other wire after stringing before attempting to work on or about it.
- 4.507** Guy or secure crossarm on which there is likely to be unbalanced pull before dead-ending wires or removing wires which could cause excessive slack or pull.
- 4.508** When pulling trolley and auxiliary wire together, attach clamp to each wire.
- 4.509** Ensure that hauling clamp is tightly secured to wire or cable before applying strain.
- 4.510** When unreeling wire, tend reel from opposite side of wire being pulled.
- 4.511** Before working on catenary crossover, section break, or pull off, de-energize, if practical, adjacent circuits with which Employees, tools, or material are likely to contact or if minimum approach distance cannot be maintained.
- 4.512** When working on a section break or section insulator, both sides of break must be de-energized, tested de-energized, and grounded.
- 4.513** Maintain vigilance around section breaks and insulators on adjacent energized wire and control personal movements and tools to avoid encroaching upon MINIMUM APPROACH DISTANCE.
- 4.514** Before releasing clearance, make a thorough check and be sure that all catenary wires are in a safe condition for electric operation, and that all Employees, tools, ground sticks, and grounded pantographs are clear of the line.

#### **4.6 CATENARY MAINTENANCE VEHICLES (CAT CARS)**

- 4.601** The Class "A" Employee holding the clearance must direct the raising of the grounded pantograph against trolley wire, when practical, before allowing personnel on top of the equipment.
- 4.602** Raise grounded pantograph against trolley wire, when practical, before applying platform temporary grounds.
- 4.603** Platform temporary protective grounds must be applied prior to workers contacting the catenary, unless working under a grounding procedure approved by ET Engineering.
- 4.604** When approaching a section break, the opposite circuit must be tested de-energized, and appropriate grounds applied, prior to passing through the break.
- 4.605** All Employees must report to the gang foreman or Class "A" Employee in charge immediately after boarding the cat car and must sign on to the clearance before going on top of the car.
- 4.606** The Class "A" Employee holding the clearance must ensure the grounded pantograph is down and locked prior to leaving de-energized tracks or releasing the clearance for the catenary where they are working.

#### **4.7 SUBSTATION WORK**

- 4.701** When closing an energized circuit breaker by hand, close contacts as quickly as possible.
- 4.702** Always clearly identify and tag any and all wires or connection before disconnecting.
- 4.703** Before working on any substation return rail bus, properly apply grounds to the bus.
- 4.704** Use all means possible to identify cables utilizing tags or labels, duct records, or following out the cable. If an improperly labeled cable is found, corrections must be made immediately, and the ADE informed.
- 4.705** Work on the control system or mechanism of high voltage equipment where the Employee is not exposed to energized conductors, can be completed under a work permit. The Employee shall describe the testing activities they intend to perform on the equipment prior to the work permit being issued. The Employee may operate the equipment as required for maintenance and testing activities. The Load Dispatcher shall ensure that the operation of the device or equipment shall not impact operations or other equipment.
- 4.706** Before working on a voltage transformer, remove the primary fuses or open the switches on the primary side and open secondary circuit.
- 4.707** Before working on electrically operated apparatus or equipment, open the control cut-out switch. If the apparatus or equipment does not have a control cut-out switch, remove DC, remove fuses, or block operating contactors in switch open.
- 4.708** Open ground return circuits between track and substation bus or apparatus grounds only after being sure that connected apparatus is de-energized.
- 4.709** Secondary circuit of energized current transformer must not be opened.

**4.710** When using a meter or testing device:

- A. Inspect the meter or test device prior to usage to check for defects and assure that the equipment is properly rated for the circuit to be tested. Do not use defective meters.
- B. Ensure meter or test device is properly calibrated.
- C. Ensure test probes are equipped with adequate insulation that is not cracked, worn, or broken.
- D. Multi-scale meters must be set on a scale that is rated higher than the test voltage, current, or resistance.
- E. Circuits to be tested should be de-energized prior to connecting meter or test device, when practical.
- F. Meters or test devices may be connected to energized circuits only when it is known that the meter or test device is properly set for the test and that adequate precautions have been taken to prevent electrical contact by testing or other personnel.
- G. Never change meter settings while a circuit is being tested. When it is necessary to change meter settings, always disconnect meter or test device first.
- H. When not in use, meters and test devices must be properly stored and secured to prevent damage.

**4.711** When working on a substation transmission line air break and grounding switch:

- A. Before starting work, first check closed, or close the motor operated grounding switch then close air break switch and then apply temporary protective grounds.
- B. After completing work and before clearance is released, check ground switch and air break switch closed, remove temporary protective grounds and then open air break switch, report position of grounding switch and air break switch to the Power Director.

**4.712** When operating disconnect or ground switches on Sulfur Hexafluoride (SF6) switchgear, the switch contacts must be visually checked through the view ports or camera system to ensure all contacts operated correctly. Never look directly into view ports while switches are being operated.

**4.713** SF6 gas must not be dispersed into the atmosphere. When it becomes necessary to add or remove SF6 gas from breakers or bus work, an approved method of handling must be used. Do not deliberately release SF6 gas to the atmosphere.

#### **4.8 CAPACITORS**

- 4.801** All rules in Section 4.8 refer to capacitors and devices with stored energy that are applied to circuits normally energized at above 480 V.
- 4.802** Before working on equipment with stored energy, obtain clearance.
- 4.803** Before grounding de-energized equipment, wait 10 minutes for capacitors to fully discharge to 50 V or less.
- 4.804** Any capacitor showing signs of bulging or leakage must be taken out of service immediately and reported to the Power Director.
- 4.805** Barricade the work area when working on or testing capacitors in a shop environment.
- 4.806** Do not rely on circuits equipped with bleed resistor systems to discharge capacitors.
- 4.807** For capacitors, apply grounds to all phases to ensure that all charges are properly dissipated.
- 4.808** Grounds and terminal shorts on capacitors must be left connected until the work is completed.
- 4.809** Do not reenergize a capacitor that is shorted terminal to terminal, shows signs of physical damage, or has a measured capacitance outside of the designed range.
- 4.810** Wait 10 minutes before reenergizing a capacitor bank after circuits have been de-energized.
- 4.811** Store or dispose of capacitors with their terminals shorted.

#### **4.9 COMMISSIONING**

- 4.901** New or modified electrical equipment or systems must undergo a commissioning process, under the direction of the Deputy Chief Engineer Electric Traction.
- 4.902** Employees will submit an ET Planned Outage Application form no less than 24 hours before a desired outage to commence with the installation or major overhaul of electrification equipment. The individuals and departments reviewing and approving such requests is included in a distribution list contained on the form.
- 4.903** Employees will prepare, assemble, and process the necessary documentation during and upon completion of commissioning. Documentation may include:
  - A. Commissioning check lists
  - B. Punch lists
  - C. As-built drawings
  - D. Equipment operation and maintenance manual
- 4.904** Commissioning check lists, when required; will be submitted to ET Engineering for review and approval.
- 4.905** Employees will prepare and submit one set of as-built prints to ET Engineering and retain a copy of as-built prints either with the equipment or on-site.
- 4.906** Employees will ensure that the manufacturers operating instructions and all associated manuals are stored either with the equipment or on-site.

## 5. RULES AND INSTRUCTIONS PERTAINING TO FREQUENCY CONVERTERS

### 5.1 FREQUENCY CONVERTER OPERATIONS

- 5.101 The Load Dispatcher must be advised of all personnel entering and leaving a converter facility.
- 5.102 Any operation of frequency converters, electrical, mechanical, or hydraulic equipment at a converter facility shall be under the direction of the Load Dispatcher.
- 5.103 Load Dispatchers and Power Directors are the only operators allowed to give switching direction to qualified Class "A" Employees. Utility companies and their dispatchers are not authorized to provide direction to Amtrak field personnel.
- 5.104 Frequency converters shall only be reset by a fully qualified Employee at the frequency converter station or under the direction of the Load Dispatcher or ET Engineering.
- 5.105 Frequency converters that have been repaired and made ready shall be placed back into operation as soon as practically possible unless under the direction of ET Engineering.
- 5.106 Converters will not be placed back in service without all relay and protection operating as designed.
- 5.107 When racking breakers in and out at frequency converter stations, remote racking equipment shall be utilized. The 40 Cal arc flash suit with associated helmet shall only be used when remote racking equipment is not available.

### 5.2 FREQUENCY CONVERTER MAINTENANCE

- 5.201 A clearance is required to enter a converter room to perform maintenance, except:
  - A. After being given permission to apply grounds or verify grounds are applied to the converter by the Power Director. The maximum distance possible shall be maintained to the de-energized (dangerous to life) apparatus.
  - B. Performing a visual inspection of the converter under the following conditions:
    1. Converter is off and blocked from starting using the approved method.
    2. Load Dispatcher has been informed of intentions to inspect converter.
    3. Employee maintains MINIMUM APPROACH DISTANCE while inside converter room.
    4. No tools or test equipment to be brought into converter room during inspection.
- 5.202 Entry to Neutral Ground Resistor fenced off areas is only permissible under a clearance.
- 5.203 Entry to filter bank areas is only permissible under a clearance.
- 5.204 Cabinet doors that are appropriately bonded to ground may be used as a barrier to ensure personnel are not exposed to energized or de-energized (Dangerous to life) equipment.

## 6. RULES AND INSTRUCTIONS PERTAINING TO THIRD RAIL ACTIVITIES

- 6.101** Third rail must always be considered energized (LIVE), except when de-energized, tested de-energized, third rail warning device applied, and protection is provided by a qualified Class "A" third rail Employee.
- 6.102** Third rail contact shoes must be considered energized (LIVE) until all contact shoes have been disconnected from the energized third rail, or the third rail is de-energized, tested de-energized, and third rail warning device applied and protection is provided by a qualified Class "A" third rail Employee.
- 6.103** Stand, walk, or work in third rail territory only in the performance of duty and only when necessary.
- 6.104** Any work over or around the third rail, that has the possibility to come into contact with the energized third rail, shall not begin unless protection has been provided by a qualified Class "A" third rail Employee.
- 6.105** The Class "A" Third Rail Employee who is obtaining a Third Rail Power Permit (NRPC 3285) will abide by all instructions outlined in SOI 220 "Third Rail Power Permit Procedure".
- 6.106** No work will be performed between the inner/near running rail and the adjacent energized (LIVE) third rail until protection has been provided by a qualified Class "A" third rail Employee. This protection may be provided by either a rubber mat or by obtaining a permit.
- 6.107** Tools, clothing, or any part of the body will not be brought in contact with the energized third rail or protection board. Contact must also never be made between the energized third rail and the track rails or ground.
- 6.108** Conductive tools or equipment may not be used for work within 4 feet of energized third rail.
- 6.109** Only qualified Class "A" third rail Employees may install approved and tested rubber mats on energized (LIVE) third rail for the protection of other Employees. Rubber mats are not an acceptable method of protection for contractors.
- 6.110** While working under rubber mat protection, tools, equipment or material must not come within 18 inches of exposed energized third rail. Only tools equipped with wooden or insulated handles may be used while under this form of protection, provided Employee's hands do not come within 3 inches of conductive portion of the tool.
- 6.111** Digging or passing tools or equipment under energized third rail is prohibited unless protection (rubber mat or power permit) is provided by a qualified Class "A" third rail Employee.
- 6.112** Only qualified Class "A" third rail Employees may work on energized (live) third rail with permission of a Supervisor and utilizing properly tested and inspected rubber gloves with leather gauntlets and insulated tools. Gloves and tools shall be inspected for defects prior to use and must have a valid (non-expired) certification with a minimum of 1,000-volt rating.
- 6.113** When practical, manually operated third rail switching and jumper operations should be conducted with minimal load on the affected circuits.

**6.114** Only qualified Class "A" third rail Employees may operate manual third rail switches or install/remove third rail jumpers. Properly tested and inspected rubber gloves with leather gauntlets must be worn during these tasks.

**6.115** Third rail maintenance and construction activities such as hucking and soldering applications will not be performed under energized (LIVE) conditions. When performing these operations, third rail protection must be provided by a qualified Class "A" third rail Employee. The third rail must be de-energized, tested de-energized, and a third rail warning device applied.

**6.116** Third rail shall not be utilized for securing any type of equipment with chains, straps or any other type of securing device.

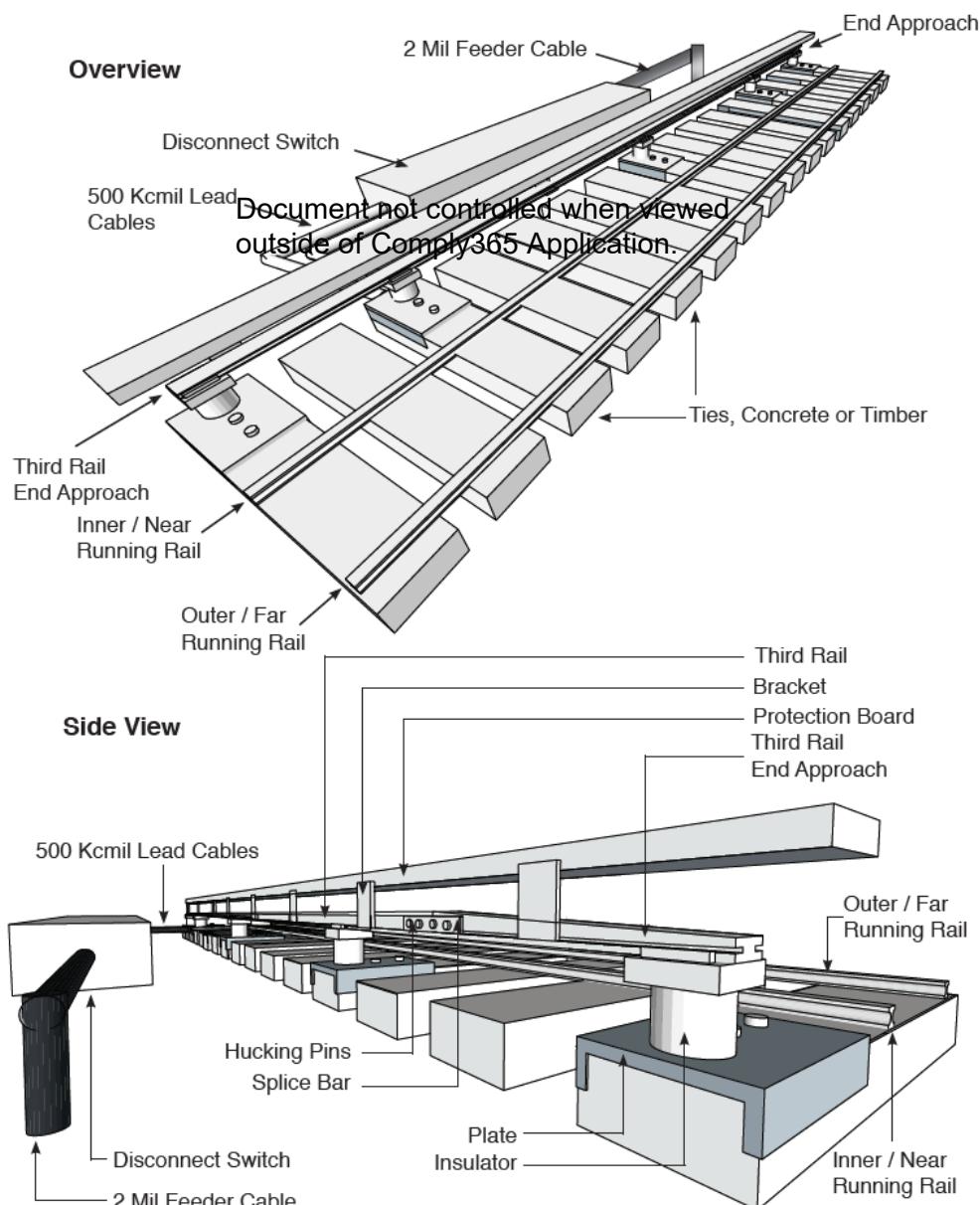


Figure 21 - THIRD RAIL SYSTEM 750 VOLTS DC

## 7. RULES AND INSTRUCTIONS PERTAINING TO CONTRACTOR PROTECTION

**7.101** Contractors must show the Class "A" Employee their contractor safety card upon request.

**7.102** Contractors will not work closer than 15 feet to overhead wires or apparatus or 4 feet to third rail unless one of the following conditions are met:

- A. Protection by a Class "A" Employee is provided.
- B. Employee is qualified in the electrical trade and a work plan has been approved by the Deputy Chief Engineer – ET or his designated representative.
- C. Protective measures are taken to prevent persons or equipment from coming in contact with exposed energized overhead lines and apparatus, such as guarding, isolating, protective barriers, and material handling techniques. The Deputy Chief Engineer – ET, or his designated representative, must approve the measures.

**7.103** If the Class "A" employee determines that a clearance is necessary, the Person in Charge of the contractor work group will see that all instructions of the Class "A" Employee are followed by his workers.

**7.104** The Person in Charge of the contractor work group will communicate all information to his group including, but not limited to:

- A. Boundaries of where work may be performed
- B. Location of nearby energized circuits
- C. Location of temporary protective grounds (if any)
- D. Clearing information

**7.105** The Class "A" Employee will determine which personnel of the contractor group will sign on and off of the clearance.

## 8. RULES AND INSTRUCTIONS PERTAINING TO POWER DIRECTORS AND LOAD DISPATCHERS

- 8.101** Power Directors must be qualified on an operating zone before accepting an assignment. A Power Director who has not performed service on an operating zone during the previous 12 months must not accept assignment to that position without approval of ET Engineering.
- 8.102** The Power Director and Load Dispatcher must establish positive contact and document any violation of the AMT-2 promptly to ET Engineering.
- 8.103** The Power Director and Load Dispatcher are responsible to identify, report, and document all system disturbances and occurrences on the Amtrak electrification system.
- 8.104** The incoming and outgoing Power Directors and Load Dispatchers must be physically present during Shift Turnover.
- 8.105** The Power Director and Load Dispatcher must identify themselves when answering the phone and radio.
- 8.106** All work-related matters, conducted by Power Directors and Load Dispatchers, will be conducted on a recorded line using three-part communication when required.

### 8.2 OPERATING RULES

- 8.201** The Power Director will determine if conditions permit the granting of the clearance or permit request and will ensure all parties affected are appropriately notified in accordance with these rules.
- 8.202** The Power Director is responsible for coordinating and maintaining an accurate record of all switching operations, clearances, or permits.
- 8.203** The Power Director must fill in the appropriate fields on all forms used to provide electrical protection. All information entered on these forms must be legible and only utilize a single strike-thru to omit errors.
- 8.204** The Power Director issues switching orders, including device location and designation, to authorize the operation of electrical devices.
- 8.205** The Power Director will direct that Do Not Operate tags be applied to manually operated devices not under SCADA control.
- 8.206** Where the rules require Power Directors to record the application of tags, they must ensure that the tags applied afford the necessary protection.
- 8.207** The Power Director will not issue any switching orders, permits, or clearances to any person who is not on the Class "A" qualified list. In the circumstance where a trainee is taking a clearance or permit under the guidance of a Class "A" Employee, the Power Director will issue such instructions to both individuals.
- 8.208** Only after the Power Director is satisfied that all switching and tagging has been done properly, will a Clearance or Permit be issued.
- 8.209** Clearance tags may not be removed unless the associated clearance or permit has been released.

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ELECTRICAL OPERATING RULES AND INSTRUCTIONS

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- 8.210** The Power Director will direct the removal of all tags and operation of all ground switches.
- 8.211** The Power Director will STOP any instruction should there be a difference of opinion or meaning until every effort has been made to reach an understanding. If an understanding cannot be reached to the satisfaction of the Power Director, the issue must be referred to the Class "A" Employee's supervisor before proceeding.
- 8.212** The Power Director will notify substation personnel prior to operating any equipment at or in a substation where personnel are known to be present.
- 8.213** The Power Director will not restore power when a power interruption occurs in the area where personnel are known to be working until contacting the person in charge and verifying all personnel and equipment are in the clear and safe.
- 8.214** The Power Director must document and report to the Train Dispatcher, relevant conditions and anomalies that have the potential to affect electric train operations.

## 9. GLOSSARY

**AC HOLD:** A term used to describe the restriction on the movement of AC electric trains or engines within a specified area. Generally issued by the Amtrak Load Dispatcher or Power Director to a Train Dispatcher.

**ARC:** A luminous and potentially destructive flash or flame in or about the wires, third rail, or electric apparatus caused by the passage of electric current through the air.

**AUTHORIZED:** Permission to work on or about an electric circuit, apparatus, or equipment or given permission to enter substations, frequency converter stations, or electrical enclosures.

**AUTHORIZED WORK AREA:** The area established by the Class "A" employee where work may be performed.

**AUTO DROP:** A feature that will automatically lower the pantograph when the air system to the pantograph has been compromised.

**AUTORECLOSE:** A feature of the electrification between New Haven and Boston. This feature will attempt to automatically close a trolley circuit breaker one time upon fault.

**AUTOTRANSFORMER:** A power transformer with only one winding that is used to boost voltage.

**AUTOTRANSFORMER FEEDER:** A feeder adjacent to the catenary that utilizes autotransformers to maintain the catenary voltage at selected points.

**AUXILIARY WIRE:** A solid wire suspended from the messenger wire to which the contact wire is attached. (See Figure 9)

**BALANCE WEIGHT ASSEMBLY:** A system of cables, pulleys, and weights at the end of a tensioning section used to maintain constant tension in the catenary. (See Figure 12)

**BROKEN PANTOGRAPH/CARBON ALARM (BPA):** An alarm generated when the air system to the pantograph has been compromised.

**BUS JUMPER:** A cable used to transmit high voltage power between pantographs and/or one unit of electric equipment to another.

**CATENARY ISOLATION SYSTEM:** A system used to de-energize and ground the catenary at terminal or service and inspection location, made up of catenary disconnect switches and catenary ground switches.

**CIRCUIT:** The complete path over which electric current is transmitted from and returned to its source.

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ELECTRICAL OPERATING RULES AND INSTRUCTIONS

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**CIRCUIT BREAKER/INTERRUPTER:** A device which normally operates automatically under conditions of overload, short circuit, or by remote control to energize or de-energize transmission lines, signal power lines, catenary, third rail, or primary circuits on electric equipment so equipped.

**CLASS "A":** Linemen, Substation Electricians, Third Rail men, Power Directors, Load Dispatchers, and C&S employees who are trained and qualified to provide protection services as well as work on or about the electrification system.

**CLASS "A" ET TRAINEE:** ET Trainees who have passed their 12 month test and Class "A" Qualification

**CLASS "A" QUALIFIED LIST:** A list of employees qualified in a defined territory to receive clearances. The Assistant Division Engineer – ET maintains the current list of Class "A" ET employees. The Assistant Division Engineer – C&S maintains the current list of Class "A" C&S employees.

**CLASS "B":** Mechanical department personnel trained to perform work on top of electric equipment in electrified territory under the conditions authorized in these instructions, for their protection only.

**CLASS "C":** Personnel qualified to perform work in electrified territory.

**CLEARANCE:** The procedure when it is determined that power must be removed from circuits or apparatus in electrified territory as governed by minimum approach distances.

**COLLECTOR HEAD ASSEMBLY:** The part of the pantograph made up of a set of carbon strips and end horns connected to the main frame of the pantograph assembly by means of an apex. (See Figure 17)

**CONTACT WIRE:** The wire in the catenary from which the pantograph collects current. (See Figures 9 & 10)

**CONTINUITY JUMPER:** An electrical connection in the overhead contact system; a short conductor installed to provide electrical continuity. A jumper capable of carrying full line current.

**CONTRACTOR:** Personnel working on or near Amtrak property that are not qualified AMT-2 Class "A", "B", or "C".

**CONTROL JUMPER:** A cable mechanically connected between electric equipment to transmit control power.

**CURRENT:** The flow of electricity through a conductor.

**DC HOLD:** A term used to describe the restriction on the movement of DC electric trains or engines within a specified area. Issued by the Zone 1 Power Director to a Train Dispatcher.

**DEAD SECTION (DS):** A de-energized section of the catenary. The limits are designated by dead section signs at locations specified in the Timetable. (See Figure 13)

**DE-ENERGIZED (DANGEROUS TO LIFE):** Electrical circuits/apparatus disconnected from the power sources are considered dangerous to life until tested de-energized and properly grounded.

**DO NOT OPERATE TAG (NEC 105):** A safety tag defining operating restrictions to an electrical apparatus.

**DTMF (DUAL TONE MODULATED FREQUENCY) RADIO CONTROLLED TRACK SWITCHES:** A radio activated dual control power switch system specifically for remotely controlling switches in yards or dark territory to improve train operation safety and efficiency.

**ELECTRIC EQUIPMENT:** Locomotives and multiple unit cars operated by power received from the catenary or third rail.

**ELECTRIC POWER:** The rate at which electric energy is transferred by an electric circuit.

**ELECTRIC TRACTION TRAINEE:** Electric Traction employees that are working towards craft specific qualifications.

**ELECTRIFIED TERRITORY:** The portion of the railroad equipped for electric train operation.

**EMERGENCY CONDITION:** A circumstance which presents a hazard to life, infrastructure, or equipment that may interfere with train movement.

**END APPROACH:** The gradual slope or incline of the third rail at the beginning and end of each third rail section. This allows for the smooth transition of the third rail shoe.

**ENERGIZED - LIVE (DANGEROUS TO LIFE):** Electrical circuits/apparatus connected to a power source.

**FORM D:** A form containing written authorizations, restrictions, or instructions, issued by the Train Dispatcher to specified individuals.

**FREQUENCY CONVERTER STATION:** A location where power is received from a local utility at 60Hz and is converted to 25Hz for distribution to Amtrak's transmission system.

**GROUND CONNECTION:** An approved electrical connection to the rail return circuit or other earth potential that is used to protect personnel, equipment, and property when work is performed in electrified territory.

**GROUNDING SWITCH:** A device that is closed to connect wires or electric apparatus mechanically to ground.

**HIGH EQUIPMENT:** Equipment that, when on top of, will place employee within 3 feet of the catenary.

**HUCKING:** The process of connecting third rail sticks at its joints, end approaches, and/or attaching high voltage cable to third rail, using a hydraulic gun. Bolts, washers, collars, and splice bars are used to secure these joints upon pressure of the hydraulic gun.

**IMPEDANCE BOND:** A device which separates signal track circuits from traction return circuits by providing a path for traction return current around insulated block joints. (See Figure 6)

**INSULATED TOOL:** Tools used by AMT-2 Qualified Employees around electrified third rail, designed with wooden or fiberglass handles for protection against electric shock.

**LIVE LINE TOOLS:** Insulated hand-held sticks for use on high voltage circuits.

**LOAD DISPATCHER:** An employee who monitors and regulates power demands for the 25 Hz electrification system.

**MAIN CIRCUIT BREAKER (MCB):** A device located on electric equipment that interrupts the flow of power from the pantograph to the Main Power Transformer.

**MESSENGER WIRE:** A stranded wire attached to supporting structures from which the Contact and/or Auxiliary wires are suspended. (See Figures 4 & 5)

**MINIMUM APPROACH DISTANCE:** The closest distance personnel or equipment is permitted to approach an energized or de-energized but not grounded circuit/apparatus. (See Tables 1 & 2)

**MULTIPLE UNITS (MU):** Electric Equipment used by commuter railroads in local passenger service. Most units have a pantograph on each car. There are some units called married pairs that have one pantograph for two units.

**OVERHEAD CONTACT SYSTEM:** A system of wires suspended between poles and bridges supporting overhead wires. (See Figures 9, 10, & 11)

- A. **FIXED TERMINATION:** A system of suspended wires fixed between poles where the tension in the wires fluctuates due to temperature changes.
- B. **CONSTANT TENSION:** A system of suspended wires fixed at one end of the wire system and provided with balance weight tensioning device on the other end to maintain constant tension during temperature changes. (See Figure 12)

**PANTOGRAPH:** A device located on top of electric equipment which collects electric power from the contact wire by means of a collector head assembly. (See Figure 17)

**PARALLELING STATION:** A substation located at controlled points along the territory where the catenary and feeder are connected through autotransformers to balance and maintain the catenary voltage.

**PERSON IN CHARGE:** The individual being Amtrak employees or contractors whose designated responsibility is to supervise the work group afforded protection by the Class "A" employee. The Class "A" employee may also be the "Person in Charge".

**PHASE BREAK (PB):** A location in the catenary where wires are arranged to provide an isolated section between different sources of power.

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ELECTRICAL OPERATING RULES AND INSTRUCTIONS

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**PLATE ORDER:** A document which acknowledges that a section of the catenary or third rail may be de-energized. It graphically communicates this fact to all involved parties that electric trains or electric equipment are prevented from entering into the de-energized area.

**POWER DIRECTOR:** An employee in charge of power distribution. He manages the operations and sectionalizing of the Electric Traction power distribution, signal power, and 3rd rail systems within their assigned territory.

**POWER DIRECTOR/TRAIN DISPATCHER:** This designation is used throughout these instructions to indicate either the Power Director or the Train Dispatcher. Either position may represent the correct employee to contact in different situations.

**POWER DIRECTOR OPERATING ZONE:** A geographical section of the Amtrak electrified system whose switching and monitoring operations are conducted under the direction of the Amtrak Power Director.

**POWER SECTIONALIZING PLATE:** A diagram which indicates the area in which there are to be no electric train or electric equipment movement.

**QUALIFIED PERSON:** An individual officially recognized as being trained and has successfully demonstrated ability to perform a particular job.

**RAIL RETURN:** The combination of rails, jumpers, impedance bonds, and cables that provide an electrical return path from the train to the substation.

**REMOTE CONTROL BOARD:** A switch panel used for the operation and supervision of Electric Traction equipment/apparatus.

**SECTION BREAK:** A location designed to provide a separation of circuits while allowing for a continuous collection of power from the catenary.

**SECTIONALIZING SWITCH:** Apparatus which is used to isolate or connect sections of the catenary, signal power, or third rail.

**SOLID HOLD:** A term used to describe the restriction on the movement of all electric equipment within a specified area. Generally issued by the Power Director to a Train Dispatcher.

**STANDARD OPERATING INSTRUCTIONS (SOI):** Instructions for the Electric Traction Department to assist employees in the safe and efficient performance of their duties.

**STATIC WIRE:** The wire normally located on top of pole which protects conductors from lightning by providing a low resistance path to ground.

**SUBSTATION:** A location where power is received at high voltage and changed to required voltages and characteristics for distribution to the catenary, third rail, and other electric apparatus. (See Figure 7)

**SWITCHING:** The operation of any electrical switchgear.

**SWITCHING STATION:** (New England Division) A location midway between substations, which provides the function of paralleling stations and switching capabilities to bypass dead sections with adjacent substation power.

**THIRD RAIL:** An electrified rail located alongside and above the inner/near running rail from which a sliding contact shoe attached to the truck of electric equipment collects power.

**THIRD RAIL GAP:** A break or separation in the third rail, which begins and ends with an End Approach.

**THIRD RAIL POWER PERMIT:** A written document that outlines the procedure followed by the Electric Traction department when it is necessary to remove power from DC circuits/apparatus in third rail electrified territory.

**THIRD RAIL SHOE (CONTACT SHOE):** A device located on the side of electric equipment that collects electric power from the third rail by means of a sliding contact.

**THIRD RAIL WARNING DEVICE:** A device attached between the third rail and inner/near running rail, which indicates an energized or de-energized circuits/apparatus.

**THREE-PART COMMUNICATION:** A form of communication where the sender states a message to the receiver, the receiver acknowledges the communication by repeating information back to the sender, and the sender confirms the message is correctly understood by the receiver by stating "that's correct".

**TRAIN DISPATCHER:** The employee responsible for the movement of trains within an assigned territory.

**TRANSFORMER:** Apparatus which serves to increase or decrease voltage.

**TRANSMISSION LINES:** A system of wires and/or cables, used to transmit power at high voltage between central generating stations and substations. (See Figures 3 & 4)

**VOLTAGE:** Electric potential or potential difference expressed in volts.

**VOLTAGE SENSING DEVICE:** A device used by qualified employees to test whether circuits/apparatus are energized or de-energized.

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## **10. RECORD OF EXAMINATION**

Name: \_\_\_\_\_

Employee Number: \_\_\_\_\_

Occupation: \_\_\_\_\_

Date of Birth: \_\_\_\_\_

## **11. SUGGESTION PAGE**

Your comments on this document are invited. Please send all suggestions to:

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SP Email

Or mail the following to

ET Electrical Operating Rules and Instructions - AMT-2  
C/o Deputy Chief Engineer - ET Office  
30th Street Station - Box 41  
Philadelphia, PA 19104

Please include with each suggestion:

Section No.

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Subsection No. (If any) \_\_\_\_\_

Page No. \_\_\_\_\_

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